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Cognitive Neuroscience Society, c/o Center for Mind and Brain, University of California, Davis
One Shields Avenue, Davis, CA 95616

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Saturday, April 17, 2010

8:30 am - 4:45 pm	Satellite Meeting "Prevention of Neurodegenerative Disease: Recent Findings and Future Directions," Salon Le Portage (Lobby Level)
12:00 - 5:00 pm	Exhibitor Check-In, Fontaine Exhibit Hall
1:00 - 4:00 pm	Satellite Meeting "Brain - Computer Interface Workshop," Fundy Room
2:30 - 7:30 pm	Pre-Paid Registration Check-In, Salon La Verriere (Lobby Level)
2:30 - 7:30 pm	Onsite Registration, Registration Counter (Convention Level)
3:00 - 5:00 pm	Slide session 1, Westmount Ballroom
	Slide Session 2, Outremont Ballroom
5:00 - 6:00 pm	Welcome Reception, Fontaine Exhibit Hall
5:00 - 7:30 pm	Exhibits on Display, Fontaine Exhibit Hall
5:30 - 7:30 pm	Poster Session A, Fontaine Exhibit Hall
7:30 pm	CNS Student Association Social Night, Hilton Hotel Bar - Bistro Bar Le Belvedere

Sunday, April 18, 2010

7:30 am - 7:00 pm	Onsite & Pre-Paid Registration Check-In, Registration Counter (Convention Level)
8:00 - 8:30 am	Continental Breakfast, Fontaine Exhibit Hall
8:00 - 10:00 am	Poster Session B, Fontaine Exhibit Hall
8:00 am - 7:00 pm	Exhibits on Display, Fontaine Exhibit Hall
9:00 - 9:40 am	YIA Special Lecture 1: Lila Davachi, Westmount Ballroom
10:00 am - 12:00 pm	Symposium Session 1, Westmount Ballroom
	Slide Session 3, Outremont Ballroom
12:00 - 1:00 pm	Lunch Break
1:00 - 3:00 pm	Poster Session C, Fontaine Exhibit Hall
2:30 - 3:00 pm	Coffee Service, Fontaine Exhibit Hall
3:00 - 4:00 pm	Announcement of the Young Investigator Awards, Montréal Ballroom
	George A. Miller Prize in Cognitive Neuroscience: Dr. Steven Pinker, Montréal Ballroom
4:00 - 5:00 pm	GAM Reception, Fontaine Exhibit Hall
5:00 - 7:00 pm	Poster Session D, Fontaine Exhibit Hall

Monday, April 19, 2010

7:30 am - 7:00 pm	Onsite & Pre-Paid Registration Check-In, Registration Counter (Convention Level)
8:00 - 8:30 am	Continental Breakfast, Fontaine Exhibit Hall
8:00 - 10:00 am	Poster Session E, Fontaine Exhibit Hall
8:00 am - 7:00 pm	Exhibits on Display, Fontaine Exhibit Hall
9:00 - 9:40 am	YIA Special Lecture 2: Kara Federmeier, Westmount Ballroom
10:00 am - 12:00 pm	Symposium Session 2, Westmount Ballroom
	Slide Session 4, Outremont Ballroom
12:00 - 1:00 pm	Lunch Break
	Federal Funding Opportunities, Westmount Ballroom (see below)
1:00 - 3:00 pm	Poster Session F, Fontaine Exhibit Hall
2:30 - 3:00 pm	Coffee Service, Fontaine Exhibit Hall
3:00 - 5:00 pm	Symposium Session 3, Westmount Ballroom
	Slide Presentation 5, Outremont Ballroom
5:00 - 7:00 pm	Poster Session G, Fontaine Exhibit Hall

Tuesday, April 20, 2010

8:00 am - 5:00 pm	Onsite & Pre-Paid Registration Check-In, Registration Counter (Convention Level)
8:00 - 8:30 am	Continental Breakfast, Fontaine Exhibit Hall
8:00 - 10:00 am	Poster Session H, Fontaine Exhibit Hall
8:00 am - 5:00 pm	Exhibits on Display, Fontaine Exhibit Hall
9:00 - 9:40 am	YIA Special Lecture 3: Adam Anderson, Westmount Ballroom
10:00 am - 12:00 pm	Symposium Session 4, Westmount Ballroom
	Slide Session 6, Outremont Ballroom
12:00 - 1:00 pm	Lunch Break
1:00 - 3:00 pm	Symposium Session 5, Westmount Ballroom
	Slide Session 7, Outremont Ballroom
2:30 - 3:00 pm	Coffee Service, Fontaine Exhibit Hall
3:00 - 5:00 pm	Poster Session I, Fontaine Exhibit Hall

Federal Funding Opportunities

Federal Funding: Training and Research Grant Opportunities

Monday, April 19, 12:00 - 1:00 pm, Westmount Ballroom
Kathy Mann Keopke, NICHD/NIH; Kathy Anderson NIMH/NIH; Lynne Bernstein, NSF

This presentation will highlight current federal training, career development, and research funding opportunities available to CNS investigators. Program Directors representing the NIH and NSF will present an overview of relevant funding opportunities at each agency, as well as a brief overview of the grant application, review, and funding processes, providing hints for successful grant writing along the way. Come learn how to advance your research with federal support!

Poster Schedule

Poster sessions are scheduled on Saturday, April 17th, Sunday, April 18th, Monday, April 19th, and Tuesday, April 20th. The presenting author should be present at least one full hour during the assigned session and the other authors should be present during the remaining time to be available to answer any questions.

The poster sessions are in the Fontaine Exhibit Hall on the Convention Level of Hilton Montréal Bonaventure Hotel. Badges are required in the Exhibit Hall at all times. The doors to the poster room will open at 5:00 pm on Saturday and at 7:30 am on Sunday - Tuesday for poster presenters only; you may post your materials on the board assigned to you at the scheduled time. The doors will close and lock for the evening at 7:45 pm on Saturday, 7:30 pm on Sunday and Monday, and 5:15 pm on Tuesday. There is no re-entry after this time. Do not leave personal items in the poster room.

The following times indicate when you are expected to set-up and take-down your poster. Note that we are asking you to leave your poster up for longer than the formal session. This will allow people to look at your poster for an extended time period. You should plan to be at your poster from the start until the end of your formal session. Please note that any posters not removed by "Take-down Ends" time will be discarded.

Poster Session	Date & Time	Set-up Begins	Session Begins	Session Ends	Take-down Ends	Topics Being Presented
A	Saturday, April 17	5:00 pm	5:30 pm	7:30 pm	7:45 pm	Emotion & Social: Person Perception Emotion & Social: Self Perception Language: Lexicon Long-Term Memory: Other Long-Term Memory: Semantic
B	Sunday, April 18	7:30 am	8:00 am	10:00 am	11:30 am	Attention: Auditory Attention: Development & Aging Attention: Multisensory Emotion & Social: Development & Aging Emotion & Social: Other Executive Processes: Development & Aging Executive Processes: Goal Maintenance & Switching Executive Processes: Other
C	Sunday, April 18	11:30 am	1:00 pm	3:00 pm	3:30 pm	Attention: Spatial Emotion & Social: Development & Aging Emotion & Social: Emotion-Cognition Interactions Perception & Action: Multisensory
D	Sunday, April 18	3:30 pm	5:00 pm	7:00 pm	7:30 pm	Language: Other Perception & Action: Audition Thinking: Decision Making
E	Monday, April 19	7:30 am	8:00 am	10:00 am	11:30 am	Emotion & Social: Emotional Responding Executive Processes: Monitoring & Inhibitory Control Executive Processes: Working Memory Language: Other

Poster Session	Date & Time	Set-up Begins	Session Begins	Session Ends	Take-down Ends	Topics Being Presented
F	Monday, April 19	11:30 am	1:00 pm	3:00 pm	3:30 pm	Executive Processes: Monitoring & Inhibitory Control Executive Processes: Other Long-Term Memory: Episodic Long-Term Memory: Skill Learning METHODS: Neuroimaging METHODS: Other Neuroanatomy Other Perception & Action: Motor Control Thinking: Other Thinking: Problem Solving
G	Monday, April 19	3:30 pm	5:00 pm	7:00 pm	7:30 pm	Emotion & Social: Development & Aging Emotion & Social: Emotion-Cognition Interactions Language: Semantic METHODS: Electrophysiology Perception & Action: Development & Aging Thinking: Development & Aging Thinking: Other Thinking: Problem Solving
H	Tuesday, April 20	7:30 am	8:00 am	10:00 am	12:30 pm	Attention: Nonspatial Attention: Other Executive Processes: Development & Aging Executive Processes: Monitoring & Inhibitory Control Long-Term Memory: Development & Aging Perception & Action: Vision Thinking: Reasoning
I	Tuesday, April 20	12:30 pm	3:00 pm	5:00 pm	5:15 pm	Language: Development & Aging Language: Syntax Long-Term Memory: Episodic Perception & Action: Other Perception & Action: Vision

Save the Date

CNS 2011
will be held
April 2-5, 2011
in San Francisco, California

16th Annual George A. Miller Prize in Cognitive Neuroscience

Sunday, April 18, 3:00 - 4:00 pm, Montréal Ballroom
Reception to follow, 4:00 - 5:00 pm, Fontaine Exhibit Hall

The Cognitive Neuroscience Society is pleased to announce the recipient of the 2010 George A. Miller Prize in Cognitive Neuroscience:

Dr. Steven Pinker, Harvard University
"Language as a Window into Human Nature"

The George A. Miller Prize in Cognitive Neuroscience was established in 1995 by the Cognitive Neuroscience Society and the James S. McDonnell Foundation to honor the career contributions of George A. Miller to cognitive neuroscience. The first 10 years of the prize were funded by generous support from the James S. McDonnell Foundation.

The prize is awarded to the nominee whose career is characterized by distinguished and sustained scholarship and research at the cutting-edge of cognitive neuroscience. Extraordinary innovation and high impact on international scientific thinking should be a hallmark of the recipient's work.

Each year a call for nominations for the George A. Miller Prize is made to the membership of the society. The recipient is selected by a committee with the approval of the society. The prize winner attends the annual meeting of the Cognitive Neuroscience Society and delivers the George A. Miller Lecture.

Young Investigator Award in Cognitive Neuroscience

Sunday, April 18, 2010, 3:00 - 4:00 pm, Montréal Ballroom
Immediately prior to the George A. Miller Award in Cognitive Neuroscience Lecture.

The Cognitive Neuroscience Society is pleased to announce the recipients of the 2010 Young Investigator Awards:

Kara Federmeier, University of Illinois
Adam Anderson, University of Toronto

The Young Investigator Awards in Cognitive Neuroscience recognizes outstanding contributions by scientists early in their careers. Two awardees are named each year by the Award Committee, and are honored at the Annual meeting of the Cognitive Neuroscience Society. Each award includes $500 to be used by the awardees toward travel costs to the meeting, or for any other purpose. YIA awardees give a 30 minute talk at the CNS meeting.

A third YIA Special Lecture has been scheduled this year to allow Lila Davachi to speak. Lila was one of last year's YIA winners, but was unable to attend the 2009 meeting.

YIA Special Lecture 1: Lila Davachi, New York University (2009 YIA Winner)

Sunday, April 18, 9:00 - 9:40 am, Westmount Ballroom

Associative Memory Formation and Consolidation

How is experience transformed into memory? And how do memories stabilize over time? I will present evidence that elements of our experience become rapidly integrated into memories through processes supported by the hippocampal system. Evidence suggests that these initial memory traces subsequently become integrated into a distributed cortical system both during offline rest and online task performance. Further, hippocampal-cortical interactions during post- encoding awake rest and during conscious reactivation predict later associative memory performance, suggesting not only that memories become distributed over time but that this transformation is beneficial to memory stability.

YIA Special Lecture 2: Kara Federmeier, University of Illinois

Monday, April 19, 9:00 - 9:40 am, Westmount Ballroom

A (micro)volt of comprehension: What electrophysiology reveals about the processing of meaning

In only hundreds of milliseconds, the brain of an experienced language user can analyze a complex, often ambiguous perceptual stimulus -- that is, a spoken, written, or signed word -- and link that stimulus to meaning. Although a long-standing view in psycholinguistics posits that word recognition is largely feed-forward and impervious to context, our work has shown instead that the comprehension system uses context information to predict semantic and even perceptual features of likely upcoming words. The fact that some of its features may be active before a word actually appears is likely an important part of what allows meaning processing to be as fast and effective as it usually is. However, prediction also appears susceptible to age- related deterioration and, when incorrect, can have processing consequences. Intriguingly, our research suggests that the brain might use both predictive and more bottom-up processing strategies in parallel, distributed across the left and right cerebral hemispheres. In particular, we have shown that whereas the right hemisphere processes language inputs in a feedforward manner, the left is more likely to generate predictions, perhaps because left hemisphere comprehension mechanisms are integrated with language production mechanisms. Overall, electrophysiological data suggest that meaning is accessed through a stimulus-elicited, temporally-delimited process that binds neural activity across a distributed, multimodal brain network, and that there are multiple pathways to comprehension.

YIA Special Lecture 3: Adam Anderson, University of Toronto

Tuesday, April 20, 9:00 - 9:40 am, Westmount Ballroom

Emotions enhance the vividness of perception and memory

Highly emotional events are thought to enhance memory consolidation, resulting in enhanced subjective vividness in later memory. A series of convergent psychophysical, electrophysiological, and functional magnetic resonance imaging investigations examined whether this enhanced mnemonic vividness reflects in part a special vividness during initial perceptual experience. Using a psychophysical magnitude estimation procedure, we found that with increasing emotional arousal, images were perceived as increasingly perceptually vivid, despite equivalence in computational metrics of bottom up physical salience as well as after controlling for eye movements as a measure of overt attention. Enhanced perceptual vividness was associated with enhanced electrophysiological activity over the occipital cortex within 200 ms of stimulus onset. Functional magnetic resonance imaging revealed a potential site of this electrophysiological activity, with enhanced BOLD response in the lateral occipital cortex (LOC) associated with more arousing and vividly perceived images. The left dorsal amygdala- substantia innominata (SI) correlated specifically with perceptual vividness related to subjective-emotional but not objective-physical salience. Finally, memory vividness in a 1-week delayed recognition test was similarly mediated by amygdala-SI and LOC recruitment, with additional engagement of the hippocampus. These findings suggest that the "flash" of highly emotional 'flashbulb memories' reflects their phenomenological salience. This phenomenological salience is related to a perceptual cortical-motivational subcortical circuit that casts perceptual and mnemonic experience in a special light.

GSP Awards

Seven abstracts are chosen each year to receive the Graduate Students Present (GSP) award. Winners are awarded a $500 travel award and identified as GSP winners in the meeting program.

GSP presentations are specially-recognized slide presentations that are scheduled and presented with the topically organized slide sessions. As with standard slide presentations, each GSP student first author is given 15 minutes to present and discuss his or her research findings.

2010 Award Recipients

Congratulations to the following winners of the 2010 GSP Award.

Molly Crockett, University of Cambridge, UK
Category: Emotion & Social

Stephen M. Emrich, University of Toronto, Canada
Category: Attention

Evelien Heyselaar, Queen's University, Canada
Category: Executive Processes

Carolyn Parkinson, Dartmouth College, USA
Category: Thinking

John Rudoy, Northwestern University, USA
Category: Long-Term Memory

Kristof Strijkers, Universitat Pompeu Fabra, Spain
Category: Language

Sara Fabbri, University of Trento, Italy
Category: Perception & Action

CNS Students Association Social Night

Saturday, April 17, 7:30 pm, Hilton Hotel Bar - Bistro Bar Le Belvedere

Come and meet other students from the Cognitive Neuroscience Society and let's explore the city!

All students of the Cognitive Neuroscience Society are welcome to join us at the Hilton Hotel Bar - Bistro Bar Le Belvedere at 7:30 pm on Saturday, April 17th (after the poster session). Please wear your name-tags so other students can easily identify you. We will introduce everyone to each other and get acquainted, and around 8:30 pm we will head out to a local bar/restaurant.

Please note that this is not a funded event and although there is no entrance fee for any of the places we are going to, you will have to pay for your own drinks and/or dinner.

Looking forward to you meeting you in Montréal!

CNSSA Executives

Sign up for the CNSSA Facebook Group at http://www.facebook.com/#!/group.php?gid=47806251696

Abstract Book

You will find the abstract book in your bag. One copy of the printed program is available to each attendee. Please check in with the Registration Counter on the convention floor of the hotel if you would like a second copy.

The program was assembled from a total of 1193 submissions. Presented are 5 symposia, 7 graduate student presentation awards, 49 slides and 1130 posters.

Every endeavor has been made to produce an accurate program. If you are presenting at the conference, please confirm your presentation times as contained within this program.

Audiovisual Equipment for Talks

LCD projectors (e.g., for PowerPoint presentations) will be provided in all rooms where spoken sessions are scheduled; however, computers will NOT be provided. Presenters must bring their own computers and set them up BEFORE the start of the session in which they are presenting. Facilities will be provided to allow several computers to be connected to the LCD projector in a room. Presenters are strongly encouraged to arrive in their scheduled symposium room a minimum of 30 minutes before their talks so that they know how to set up their equipment.

Automatic Teller Machines (ATM) & Banks

An ATM is located in the hotel lobby near the gift shop. Foreign currency is available through the front desk while full banking facilities can be found at Place Ville-Marie (underground access).

Baggage Check

For those staying at the Hilton Montréal Bonaventure Hotel, assistance with luggage, packages and other carry-on's, is located with the Concierge, next to the front desk.

A coat check will also available on the convention floor, in front of the Mont-Royal room, for a small fee.

Business Center

The Business Center is self-serve, 24hr, credit card operated (with access using your hotel room key), and is located in the Lobby next to the front desk. It offers full business services including fax, copying, computer and Internet access.

Catering

Catering will be available during the conference and is included in the registration fee. Please refer to the table below for the catering times. All food events are in the Fontaine Exhibit Hall.

	Saturday April 17	**Sunday April 18**	**Monday April 19**	**Tuesday April 20**
Receptions	Welcome Reception 5:00 pm - 6:00 pm	GAM Reception 4:00 pm - 5:00 pm		
Breakfasts		8:00 am - 8:30 am	8:00 am - 8:30 am	8:00 am - 8:30 am
Coffee Breaks		2:30 pm - 3:00 pm	2:30 pm - 3:00 pm	2:30 pm - 3:00 pm

Certificate of Attendance

To receive a Certificate of Attendance please visit the registration desk. If you require any amendments, we will be happy to email/mail a copy after the meeting. See also Receipts.

Chair People

Please ensure that you are available in your presentation room at least thirty minutes before the start of the session. Persons chairing sessions are asked to keep the talks on time.

Concierge

The Hilton Montréal Bonaventure Hotel Concierge is located in the Lobby next to the front desk. The concierge can assist you with car rentals, information about the Montréal Underground, maps, restaurant reservations, flight schedule confirmation, taxi and shuttle service, tourist attractions, and theater, concert, and event tickets.

Disclaimer

The Convention Committee reserves the right to change the meeting program at any time without notice. Please note this program is correct at time of print.

Duplication/Recording

Photography, audiotaping, video recording, digital taping or any other form of duplication is strictly prohibited in the sessions and poster areas.

Exhibit Hall

The Conference Exhibit is located in Fontaine Exhibit Hall on the Convention Level of the Hilton Montréal Bonaventure Hotel. Located in this room are the posters, exhibit booths, and catering. The Exhibit Hall is open at the following times:

Saturday, April 17	5:00-7:30 pm
Sunday, April 18	8:00 am - 7:00 pm
Monday, April 19	8:00 am - 7:00 pm
Tuesday, April 20	8:00 am - 5:00 pm

The exhibit hall will be locked promptly at the end of each day. There is no admittance until the following day.

Future Meetings

Please join us for the 2011 annual meeting in San Francisco, April 2nd-5th. We welcome ideas for the location of the 2012 meeting.

Hotel

The Hilton Montréal Bonaventure Hotel is our exclusive Hotel for the CNS 2010 Annual Meeting and where all CNS 2010 meeting events will be held.

Hilton Montréal Bonaventure Hotel, 900 de La Gauchetière Ouest (West), Montréal, Canada H5A 1E4

With 2.5 acres of landscaped gardens, stream and brook, Hilton Montréal Bonaventure Hotel is a unique urban resort hotel in downtown Montréal, Canada. Free WiFi internet service is available in the Lobby. The hotel is directly connected to the underground city and subway.

Hotel Restaurants

Le Castillon, one of Montréal's fine dining institutions, is located off the hotel lobby. Breakfast is served daily from 6:30 - 11:00 am, Monday-Saturday or 6:30 - 10:00 am on Sunday. Brunch is served on Sunday from 11:00 am - 3:00 pm. Lunch is served daily from noon to 2:00 pm.

Le Belvedere Bistro Bar is nestled in the lobby center. Ideal location to meet with friends or colleagues for cocktail hour or a light meal from the a la carte menu. Open daily from noon to midnight.

Hilton Fitness Center

The center is open to hotel guests 24 hours a day with state-of-the-art Precor fitness equipment. For those who prefer a more relaxed physical activity, a private yoga room is available. Or take a leisurely stroll through the 2.5 acres of rooftop green space.

The fabulous outdoor rooftop heated pool of the Hilton Montréal Bonaventure Hotel is open 365 days a year.

Internet Café/Wireless Connection

WiFi internet access is available in the lobby and will also be available in the Meeting Space for the conference.

An Internet Café will be located under the escalator near the Registration Counter (Inscription Desk) on the convention floor. The Internet Café is available free of charge to attendees, exhibitors, and speakers, and will be open during Registration hours on Saturday, April 17 through Tuesday, April 20 (when not needed for onsite registration purposes). If you are registering onsite, you may speed up the process by completing the onsite registration form under the "meeting" tab at www.cnsmeeting.org.

Saturday, April 17	2:30 - 7:30 pm
Sunday, April 18	7:30 am - 7:00 pm
Monday, April 19	7:30 am - 7:00 pm
Tuesday, April 20	8:00 am - 5:00 pm

Lost & Found

Lost and Found is located at the Registration Counter on the convention floor of the hotel.

Meeting Rooms

The meeting rooms for symposia, slides, and special sessions are on the Convention Level of the Hilton Montréal Bonaventure Hotel.

Message Center

Messages for meeting registrants can be left and retrieved at the Registration Counter on the convention floor of the hotel. A bulletin board will be available for announcements and job postings.

Mobile Phones

Attendees are asked to silence their mobile phones when in sessions.

Name Badges

The Hilton Montréal Bonaventure Hotel and Convention Center is open to public access. For security purposes, attendees, speakers and exhibitors are asked to wear their name badges to all sessions and social functions.

Entrance into sessions is restricted to registered attendees only. Entrance to the Exhibition will be limited to badge holders only. If you misplace your name badge, please go to the Registration Counter on the convention floor of the hotel for a replacement.

Parking

The Hilton Montréal Bonaventure Hotel offers secured and covered parking. Parking rates are currently $18.00/24 hour (self park), or $25.00/24 hour for Valet parking.

Poster Sessions

Poster sessions are scheduled on Saturday, April 17th, Sunday, April 18th, Monday, April 19th, and Tuesday, April 20th. The presenting author should be present at least one full hour during the assigned session and the other authors should be present during the remaining time to be available to answer any questions. The poster sessions are in the Fontaine Exhibit Hall on the Convention Level of Hilton Montréal Bonaventure Hotel. Badges are required in the Exhibit Hall at all times. The doors to the poster room will open at 5:00 pm on Saturday and at 7:30 am on Sunday - Tuesday for poster presenters only; you may post your materials on the board assigned to you at the scheduled time. The doors will close and lock for the evening at 7:45 pm on Saturday, 7:30 pm on Sunday and Monday, and 5:15 pm on Tuesday. There is no re-entry after this time. Do not leave personal items in the poster room.

Please see the Poster Schedule chapter for set-up and take-down times.

Receipts

A receipt is located on the back of your name badge. CNS does not mail badges, so the badge acts as both the receipt and assurance of attendance. You will also receive two receipts online, one from CNS Meeting for registration and one from PayPal for payment. See also Certificate of Attendance.

Receptions

The Welcome Reception will be held in Fontaine Exhibit Hall, from 5:00 - 6:00 pm on Saturday, April 17, directly following the first slide sessions. Join us on Sunday, April 18, from 4:00 - 5:00 pm in the Fontaine Exhibit Hall, for a reception honoring Dr. Steven Pinker, winner of the 16th Annual George A. Miller Prize in Cognitive Neuroscience directly following his talk.

Registration

Pre-Paid Registration (badge pickup) will be held in Salon La Verriere on the Lobby level of the Hilton Montréal Bonaventure Hotel on the first day of the conference, Saturday, April 17. To pick up your badge on Sunday-Tuesday, go to the Registration Counter (Inscription Desk, Convention Level).

Onsite Registration will be at Registration Counter (Inscription Desk) located at the base of the elevator on the convention floor. If you are registering onsite, you must first complete the registration submission form online at www.cnsmeeting.org.

Registration Hours

Saturday, April 17*	2:30 - 7:30 pm
Sunday, April 18	7:30 am - 7:00 pm
Monday, April 19	7:30 am - 7:00 pm
Tuesday, April 20	8:00 am - 5:00 pm

**Pre-Paid Registration badges are located in Salon La Verriere (Lobby Level) on Saturday only; Onsite Registration badges can be purchased at the Registration Counter (Convention Level).*

Scientific Sessions

Scientific sessions will take place from 3:00 pm on Saturday, April 17 until 5:00 pm on Tuesday, April 20, 2010.

Smoking

Smoking is not permitted in or outside any of the meeting rooms or the exhibition hall.

Speakers

All speakers must register and wear name badge to present. Please ensure that you are available in your presentation room at least thirty minutes before the start of the session. See also Audiovisual Equipment for Talks.

Special Dietary Requirements

If you have advised us of special dietary requirements, please speak to a member of the catering staff. The catering staff will have a full list of attendees with special dietary requirements.

Taxes

The goods and services tax/harmonized sales tax (GST/HST) may apply to various goods and services you purchase during your stay in Canada. The GST rate is 5%, and the HST rate is 13%.

The Government of Canada has eliminated the GST/HST Visitor Rebate Program and announced the introduction of the Foreign Convention and Tour Incentive Program. For more information, visit Questions and Answers on the Cancellation of the Visitor Rebate Program, and the Implementation of the New Foreign Convention and Tour Incentive Program at http://www.cra-arc.gc.ca/E/pub/gi/notice221/README.html.

Transportation

Taxis - There is a taxis stand at the front of the Hotel. Montréal-Trudeau International Airport (YUL), formerly Montréal-Dorval international Airport, is 20 km (about 20 minutes) from the hotel. Fixed fares for taxis and limousines are $38.00 CAD and $49.50 CAD, respectively.

Bus or Shuttle - L'Aérobus, operated by Groupe La Québécoise, provides an efficient connection by motor bus between Montréal-Trudeau airport and downtown Montréal. One-way adult fare is $16.00 CAD.

Regional shuttle, Mont-Tremblant Shuttle, and City Buses (STM) are also available.

CNS 2010 Exhibitors

Visit our exhibitors in the Fontaine Exhibit Hall on the Convention Level of the Hilton Montréal Bonaventure Hotel. The Exhibit Hall is open at the following times:

Saturday, April 17	5:00 - 7:30 pm
Sunday, April 18	8:00 am - 7:00 pm
Monday, April 19	8:00 am - 7:00 pm
Tuesday, April 20	8:00 am - 5:00 pm

Exhibiting companies:

ANT-Advanced Neuro Technology

BIOPAC Systems, Inc.

Brain Vision LLC

Cedrus Corporation

Compumedics USA

Cortech Solutions, Inc.

Electrical Geodesics, Inc.

Electrode Arrays/JNetDirect Biosciences

Elsevier

Harvard Apparatus Canada

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Symposium Session 1

Sunday, April 18, 10:00 am - 12:00 pm
Westmount Ballroom

TOWARDS A CUMULATIVE SCIENCE OF HUMAN BRAIN FUNCTION

Sunday, April 18, 10:00 am - 12:00 pm, Westmount Ballroom

Chair: Tal Yarkoni, Columbia University, University of Colorado at Boulder
Speakers: Tal Yarkoni, David Van Essen, Tor Wager, Russell Poldrack

This symposium is designed to promote development of a cumulative science of human brain function that advances knowledge through formal synthesis of the rapidly growing functional neuroimaging literature. The first speaker (Tal Yarkoni) will motivate the need for a cumulative approach by highlighting several limitations of individual studies that can only be overcome by synthesizing the results of multiple studies. The second speaker (David Van Essen) will discuss the basic tools required in order to support formal synthesis of multiple studies, focusing particular attention on SumsDB, a massive database of functional neuroimaging data that can support sophisticated search and visualization queries. The third and fourth speakers will discuss two different approaches to combining and filtering results from multiple studies. Tor Wager will review state-of-the-art approaches to meta-analysis of fMRI data, providing empirical examples of the power of meta-analysis to both validate and disconfirm widely held views of brain organization. Russell Poldrack will discuss a novel taxonomic approach that uses collaboratively annotated meta-data to develop formal ontologies of brain function. Collectively, these four complementary talks will familiarize the audience with (a) the importance of adopting cumulative approaches to functional neuroimaging data; (b) currently available tools for accessing and retrieving information from multiple studies; and (c) state-of-the-art techniques for synthesizing the results of different functional neuroimaging studies into an integrated whole.

A B S T R A C T S

MOTIVATING A CUMULATIVE COGNITIVE NEUROSCIENCE Tal Yarkoni[1,2]; [1]Columbia University, [2]University of Colorado at Boulder — Thousands of functional neuroimaging studies are published every year. Only a small fraction of these studies explicitly attempt a formal synthesis of previous findings. In this talk, I argue for an increased emphasis on cumulative approaches to the study of brain function that aim to synthesize and distill the results of previous studies. Three different motives for such an approach are discussed, including (a) the need to distinguish real findings from false alarms; (b) the desire to organize both cognitive tasks and brain activations into coherent ontologies; and (c) the high likelihood that many fMRI studies are underpowered and consequently produce distorted results. I focus primarily on the last of these points, using simulations and empirical analyses to demonstrate that the results of many individual fMRI studies are likely to appear considerably stronger and more selective than they actually are. I conclude by arguing that these limitations are difficult or impossible to overcome in individual studies, necessitating a stronger focus on consensus building at the disciplinary level.

LOST IN LOCALIZATION – BUT FOUND WITH FOCI! David Van Essen[1]; [1]Washington University in St. Louis — More than 50,000 studies related to functional imaging of the human brain have been published in recent decades. Of these, more than 10,000 report key experimental data (centers of fMRI activation foci, etc.) in tables of stereotaxic coordinates ('foci') in one or another standardized atlas space. To aid in mining this extensive literature, we developed the the SumsDB database (http://sumsdb.wustl.edu/sums/), which supports storage, visualization, and searching of many types of neuroimaging data. SumsDB includes a Foci Library that currently contains >40,000 foci from ~1,400 published studies. This includes comprehensive coverage of five major journals and almost 15% of the relevant literature. Foci searches can be based on many criteria (e.g., cortical area or region, spatial coordinates, functional criteria, or disease condition). Search results can be viewed online (WebCaret) or downloaded for offline visualization and analysis using Caret sofware. As the Foci Library continues to expand, through contributions from curators and volunteers alike, it will become increasingly valuable as a way to efficiently access the burgeoning neuroimaging literature.

CONSENSUS-BUILDING AND BRAIN-BASED TAXONOMIES USING META-ANALYSIS Tor Wager[1]; [1]University of Colorado at Boulder — Much of cognitive and affective neuroscience has centered on identifying particular brain regions or circuits with categories of psychological processes. Properly synthesized, the accumulation of knowledge can aid in this goal. However, without synthesis, more information is not necessarily better, as it may be difficult to separate truly activated brain regions from spurious or idiosyncratic findings. Meta-analysis of neuroimaging data provides a potential solution to this problem. I will present methods and findings from meta-analyses of both cognitive control and emotion. Meta-analyses of cognitive control reveal a consensus on the prefrontal cortical networks involved in cognitive control processes, and a complexity-dependent posterior-anterior hierarchy of prefrontal activity that complements recent findings on prefrontal organization. Conversely, meta-analyses of emotion argue against several long-standing principles of organization of the emotional brain, paving the way for the development of new models. These findings illustrate the utility of meta-analysis in developing taxonomies of psychological processes based on the patterns of brain activity they elicit rather than folk psychological categorization schemes. I will close the talk by presenting a brain-based classification of psychological tasks that suggests that different quadrants of the brain respect different organizational schemes.

ONTOLOGIES FOR COGNITIVE NEUROSCIENCE Russell Poldrack[1]; [1]University of Texas at Austin — The stated goal of cognitive neuroscience is to understand how mental function is enabled by the brain. An unstated assumption is that we understand the mental processes that are being mapped onto the brain, but in reality there is little agreement on the structure of mental processes and how they are measured. For this reason, most meta-analyses are focused on comparisons of tasks rather than the underlying mental processes. I will argue that the systematic mapping of mental processes onto brain systems will require the development of a formal ontology of mental function. Using databases of neuroimaging data that are annotated according to such an ontology, it is possible to determine which brain systems are associated with particular mental processes, and also to determine which mental processes can be distinguished from one another according to their associated neural activity patterns. I will provide examples of this approach using both whole-brain fMRI data and results from the BrainMap database.

Symposium Session 2

Monday, April 19, 10:00 am - 12:00 pm Westmount Ballroom

PREFRONTAL CORTEX AND PERCEPTUAL DECISION MAKING

Monday, April 19, 10:00 am - 12:00 pm, Westmount Ballroom

Chair: Hakwan Lau, Columbia University

Speakers: John Serences, Hakwan Lau, Hauke Heekeren, Christopher Summerfield

Formal analysis has shown that the prefrontal cortex is anatomically the final converging point of the dorsal and ventral stream of visual processing. However, empirical investigation of visual perception is often focused on posterior areas of the brain. This bias is recently beginning to be rectified, partly due to new data collected with whole-brain methods such as fMRI in human subjects. These new findings call for new ideas regarding what role the prefrontal cortex plays in visual processing. We review the latest work on this issue, and specifically focus on formal models of perceptual decision making (e.g. probabilistic models of evidence accumulation). The speakers will present new ideas that may help to resolve apparent conflicts in recently reported results.

A B S T R A C T S

NEURAL MECHANISMS OF VALUE AND EVIDENCE BASED DECISION MAKING John Serences[1]; [1]University of California San Diego — I will discuss studies examining the neural mechanisms that support decisions that are based on either the quality of sensory evidence or the probability of reward. Formal models are used to reveal the latent variables that govern choice behaviour in order to guide theoretically motivated investigations into the neural mechanisms of decision making. In the first set of studies, I will argue that the subjective value of a stimulus biases the overall magnitude of cortical responses in early sensory areas (e.g. V1). Moreover, the use of high-resolution fMRI and feature selective voxel tuning functions suggests that value also influences the precision of sensory responses so as to enhance the distinctiveness of valuable objects. Next, I will present data that employs accumulator models of perceptual decision making to investigate the higher-order mechanisms that integrate evidence about low-level stimulus features from early areas of sensory cortex. By combining the predictions of these models with simulations of the BOLD response, predictions about the timecourse and amplitude of activation changes reveal both task specific and task general sites of evidence accumulation in human cortex. Together, these findings suggest that top-down factors like subjective value influence the quality of the sensory representations that form the input to the downstream decision mechanisms that ultimately guide motor interactions with objects in the environment.

THE ROLE OF THE PREFRONTAL CORTEX IN MAKING SUBJECTIVE RATINGS OF PERCEPTUAL CERTAINTY AND VISIBILITY Hakwan Lau[1,2]; [1]Columbia University, [2]Donders Institute for Brain, Cognition and Behavior, Netherlands — When making perceptual decisions, humans, monkeys, as well as non-primate subjects can give subjective reports such as confidence or visibility ratings. We developed psychophysical paradigms under which the subjective ratings can be dissociated from the objectively measured capacity for perceptual processing (e.g. d' in signal detection theoretic terms) - subjects claimed that they saw more or were more certain of their decisions in some conditions even when the performance was the same. Using fMRI, we showed that when perceptual capacity was matched, activity in the dorsolateral prefrontal cortex reflects the subjective ratings. Transcranial magnetic stimulation (TMS) to this regions impaired subject's ability to report their ratings properly. Formal comparison of computational models suggests that subjective ratings depend on a late stage of information processing in a hierarchy (instead of depending on a separate channel, or the same information that drives the perceptual decision). We argue that the prefrontal cortex supports self-monitoring processes at this late stage.

NEURAL MECHANISMS OF REWARD RATE OPTIMIZATION IN PERCEPTUAL DECISION MAKING Hauke Heekeren[1]; [1]Max Planck Institute for Human Development, Germany — Decision makers determine perceptual decisions by collecting evidence until reaching a point of choice. They can either make decisions quickly, thereby risking more errors, or make decisions carefully, thereby risking to have fewer opportunities for being maximally rewarded. Single unit recording studies in monkeys have shown that prefrontal (DLPFC) and striatal brain regions are involved in this Speed Accuracy Tradeoff, however their interaction remains unclear. Computational network models suggest a modulation of the connectivity (synaptic efficiency) between striatal and cortical neurons as the neurobiological mechanism by which decision makers adapt their behavior and thereby optimize their reward rate. We used fMRI to investigate this connectivity hypothesis. Participants performed a motion direction discrimination task, in which rewards emphasized either accuracy, or speed, or both. Hence participants had to trade off speed and accuracy depending on the reward condition to maximize reward. Behaviorally, subjects appear to maximize their overall task reward by adjusting the amount of evidence required before making a decision. In a conjunction analysis over all task conditions our neuroimaging results reveal significant activation in the bilateral dorsolateral prefrontal cortical regions of the brain. We used these DLPFC regions as seeds in a subsequent Psychophysiological Interaction analysis to investigate the connectivity hypothesis. We found a significant modulation of the coupling of the Basal Ganglia System to DLPFC seed regions when comparing the different reward conditions. The results suggest that depending on the prevailing optimal strategy, reward optimization is achieved by way of modulating the coupling between cortical and striatal regions.

THE ECONOMICS OF VISUAL CATEGORISATION Christopher Summerfield[1]; [1]University of Oxford — Visual category judgements have been successfully described by quantitative models which evisage the decision process as an accumulation of evidence towards a criterial threshold (or 'bound'). These 'bounded accumulator' models are supported by evidence from single-cell recordings in the parietal and prefrontal cortices. However, visual detection and discrimination can be biased by information concerning the relative costs or benefits associated with each categorical alternative, and by estimates of their probability of occurrence. My talk will address how visual category judgements are biased within the framework of the bounded accumulator model. Rewards bias fast decisions more than slow decisions, a phenomenon that can be modelled by a shift in prior estimates of perceptual evidence, and estimates of prior evidence may correlate with fMRI signals in the lateral parietal and orbitofrontal cortices. Secondly, I will discuss how ongoing estimates of the dispersion and volatiliy associated with a visual category influence perceptual decision-making. Although humans may learn optimally about the variance of two visual categories, discrimination decisions are biased towards 'confirming' that discriminanda come from the category with least variance. This effect is also associated with brain structures involved in the processing of expectations about reward.

Symposium Session 3

Monday, April 19, 3:00 - 5:00 pm
Westmount Ballroom

BRAIN OSCILLATIONS, DYNAMIC SYNCHRONY, AND COGNITION

Monday, April 19, 3:00 - 5:00 pm, Westmount Ballroom

Chair: Michael Cohen, University of Amsterdam

Speakers: Michael Cohen, Bijan Pesaran, Nancy Kopell, Jean-Marc Fellous

Paramount among brain functions is interpreting the sensory world and producing appropriate responses. Because the brain comprises specialized processing areas for sensory decoding, integration, memory, and motor generation, spatially disparate and functionally divergent brain regions need to form functionally unified neural networks. And because the world can change so quickly, interactions among brain regions must be extremely temporally precise (milliseconds to tens of milliseconds). Recording electrophysiological signals such as action potentials and local field potentials provide sub-millisecond-resolution windows into the timing of activity within and across neural networks. Cognitive processes elicit idiosyncratic spatio-temporal profiles of activity, which often have strong oscillatory components, and involve multiple spatial and temporal scales. These interactions may be the basis of neural information coding and transfer schemes. This symposium will highlight recent advances in our understanding of the dynamics of how neural networks form from synchronized electrophysiological activity, and the implications of these dynamics for the functional and cognitive architecture of the brain. Topics will span perception, learning, and decision-making, and from rat, monkey, human, and modeling approaches.

A B S T R A C T S

SYNCHRONIZED NEURAL OSCILLATIONS SUPPORT COGNITIVE CONTROL AND REINFORCEMENT LEARNING Michael Cohen[1]; [1]Dept of psychology, University of Amsterdam — The medial prefrontal cortex (MFC) is critical for our ability to flexibly adapt our behavior according to rules that we've learned or have been told. But the MFC cannot act alone; rapidly and flexibly assessing and responding to the environment requires the MFC to interact with multiple sensory and motor systems with millisecond temporal precision. I will review recent evidence that the human MFC uses long-range oscillatory synchrony (1) to receive information from sensory and motor systems ("bottom-up") about possible conflicts or errors, and (2) to direct sensory, motor, and motivation systems ("top-down") to improve current and future performance. MFC-centric, spatially disparate, but functionally linked neural networks are activated during conflicts or errors, predict performance adjustments, and occur independent of conscious awareness. Further, the dynamics of these rapid inter-regional communications are often not mirrored in the amplitude of activity of any isolated brain region, demonstrating that precise timing within and among brain networks provides novel insights into brain function. Evidence will be presented from healthy students, patients with simultaneous nucleus accumbens-MFC recordings, and healthy ageing.

NEURAL DYNAMICS, DECISIONS AND ACTIONS Bijan Pesaran[1]; [1]New York University — Cerebral cortex contains a mosaic of brain areas that are connected to form distributed networks. Before each movement we decide to make, multiple areas contain specific patterns of neural activity which can be used to predict what we will do. This talk will present our investigations into dynamics of neuronal activity that seek to understand how interactions between brain areas guide sensory-motor behavior. We have been focusing on parietal area LIP which guides saccadic eye movements together with the Parietal Reach Region (PRR) and dorsal premotor cortex (PMd) which guide arm movements. I will present studies in the monkey that examine how neural dynamics are reflected in the activity of single cells and field potentials, how these dynamics exhibit functional specializations across different cortical areas, and how neural coherence between cortical areas is involved in behaviors such as making a decision and coordination. These studies illustrate how investigations of neural dynamics can help us understand the relationship between the activity of distributed cortical networks and behavior.

RHYTHMS, CELL ASSEMBLIES AND BINDING IN THE NERVOUS SYSTEM: FROM PHYSIOLOGY TO FUNCTION Nancy Kopell[1]; [1]Boston University — It has been known for a long time that the brain can produce rhythmic patterns of electrical activity, and that these can be associated with cognitive activity. However, it remains controversial whether these rhythms participate in cognition, or simply reflect processes that happen during cognition. To make the case that rhythms are functionally important, it is necessary to understand the mechanisms by which the rhythms alter processing in the nervous system. This line of research is still in its infancy, but there is enough to see how such arguments might work. This talk focuses on the gamma (35 -90 Hz) and beta (12-30 Hz) frequency bands, using models to show how the differences in physiology underlying at least some versions of those brain rhythms have different and complementary properties with respect to the creation and interaction of cell assemblies, providing a framework for understanding a variety of data, including some on decision-making.

KEEP IT IN MIND: REACTIVATION IN THE VENTRAL TEGMENTAL AREA OF THE RODENT Jean-Marc Fellous[1]; [1]University of Arizona — In a rest period immediately after a learning task, neurons in hippocampus, neocortex and striatum become active in spatiotemporal patterns resembling those during the task. This reactivation consists in a precise, millisecond-scale replay of bouts of neural activity and has been proposed as a neurophysiological substrate for memory consolidation. It is still unknown why some memory items are consolidated and others are not. We provide evidence that rodent Ventral Tegmental Area (VTA) neurons are selective for different types of rewards and that reward sensitive neurons strongly reactivate during the rest period following a task that involved rewards. Non-reward sensitive neurons exhibited significant reactivation only if the task involved a substantial motor component. The VTA is a pivotal structure involved in the coding of reward and stimulus salience, and is a key neuromodulatory system involved in synaptic plasticity. The reactivation of this neural population in the rat suggest a new way in which memory consolidation in cognitive structures such as the hippocampus and cortex can be modulated by the affective significance of the items to remember.

Symposium Session 4

Tuesday, April 20, 10:00 am - 12:00 pm
Westmount Ballroom

DOPAMINE AND ADAPTIVE MEMORY

Tuesday, April 20, 10:00 am - 12:00 pm, Westmount Ballroom

Chair: Daphna Shohamy, Columbia University

Co-Chair: Alison Adcock, Duke University

Speakers: Emrah Duzel, Alison Adcock, Daphna Shohamy, Nathaniel Daw

The aim of this symposium is to highlight recent advances in understanding the role of episodic memory in decision making and adaptive behavior, with a focus on how dopamine and the hippocampus support these processes. It is widely recognized that dopamine contributes to a specialized system for gradual, feedback-based learning in the striatum. However, emerging evidence suggests that dopamine plays a much broader role in learning and memory. In particular, it is now clear that dopamine also contributes to hippocampal function and is a critical determinant of successful memory formation. The talks in this symposium bring together converging evidence from multiple levels of analysis, including human neuroimaging, computational models and patient research. Together, these different perspectives argue for a framework in which dopamine helps create enriched mnemonic representations of the environment to support adaptive behavior in novel situations.

ABSTRACTS

NOVELTY-RELATED MOTIVATION OF ANTICIPATION AND EXPLORATION BY DOPAMINE Emrah Duzel[1]; [1]University College London — Studies in humans and animals show that dopaminergic neuromodulation originating from the substantia nigra/ventral tegmental area (SN/VTA) of the midbrain enhances hippocampal synaptic plasticity for novel events and has a motivationally energizing effect on actions through striatal mechanisms. In this talk, I will discuss how these mechanisms of dopaminergic neuromodulation connect to the behavioural and functional consequences that age-related structural degeneration of the SN/VTA exerts on declarative memory. A framework model called 'NOvelty-related Motivation of Anticipation and exploration by Dopamine' (NOMAD) is proposed which merges existing links between novelty, dopamine, long-term memory, plasticity, energization and their relation to aging. The model captures how maintaining mobility and exploration of novel environments could be useful to slow age-related decline of memory. Furthermore, components of the model have potential relevance for optimizing memory strategies in both healthy and memory-impaired individuals.

MEMORY IN SERVICE OF GOALS: AFFECTIVE NEUROMODULATION AND MNEMONIC SALIENCE MAPS Alison Adcock[1]; [1]Duke University — A little information has the potential to radically change behavior. Information that we encode and remember - declarative memory - is built from autobiographical episodes into narratives and multi-dimensional representations of relationships that define the environment. These narratives, the lessons we derive from them, and the environments that evoke them can alter behavior immediately and persistently. For better and worse, such memories are not veridical records of reality, but rather over-represent information that matters to us. I will discuss emerging fMRI data suggesting that dopaminergic neuromodulation allows motivation and expectation to influence memory encoding for upcoming events, and behavioral data suggesting that motivational states influence both what is encoded and how it is represented in memory. In this framework, approach motivation engages a predictive neuromodulatory system centered around mesolimbic dopamine projections. This system primes the medial temporal lobe memory system to record memories of upcoming events and contexts, creating mnemonic 'salience maps'. Recent evidence from my laboratory, together with other findings, suggests that dopaminergic modulation promotes processing and plasticity in the hippocampus, resulting in detailed, specific representations well-suited to supporting flexible navigation required for acquisition. This effect differs from modulation during avoidance motivation, which appears to promote predominant processing and plasticity in medial temporal cortex, resulting in unitized representations well-suited to eliciting stereotyped behaviors like freezing. Our data suggest that dopamine tailors both the content and the form of declarative mnemonic representations to support future adaptive behavioral responses consistent with the motivational state at the time of encoding.

LEARNING TO PREDICT OUTCOMES: EVIDENCE FROM NEUROPSYCHOLOGY AND NEUROIMAGING IN HUMANS Daphna Shohamy[1]; [1]Columbia University — Rewards powerfully affect learning. This can be adaptive, allowing organisms to learn to obtain food, money and other important rewards. Rewards that are too powerful, however, can be maladaptive, creating strong habits that are hard to break. Recent research on reward and learning has focused on the role of the striatum and midbrain dopamine regions in habitual learning of stimulus-reward associations. However, emerging evidence suggests that the hippocampus – widely known for its role in episodic or relational learning – is also modulated by reward and is substantially innervated by dopamine. This raises important questions regarding the role of the hippocampus in learning, the unique contributions of the hippocampus and the striatum to learning, and the nature of the relationship between them. I will talk about recent studies that address these questions using functional imaging (fMRI) and patient studies in humans. Converging data from these two approaches suggests that both the striatum and the hippocampus contribute to learning, with distinct implications for how learned information is used. In particular, I will present data suggesting that the striatum guides behavior when choice options are repeated, while the hippocampus builds flexible memories that support transfer of learned knowledge to novel situations. I will discuss the implications of these results for understanding how multiple brain systems contribute to adaptive learning processes.

REINFORCEMENT LEARNING: BEYOND REINFORCEMENT Nathaniel Daw[1]; [1]New York University — The spiking of dopamine neurons in animals, and apparently analogous BOLD signals at dopaminergic targets in humans, appear to report predictions of future reward. Although prominent computational theories of reinforcement learning suggest that these responses support and reflect learning about decisions based on simple associations with past rewards, it has long been known, behaviorally, that beyond this Thorndikian principle of reinforcement, animals and humans can make decisions drawing on other sorts of knowledge about task structure and contingencies. I first discuss how these additional influences – e.g., simulation or "mental time travel" based on cognitive maps or declarative knowledge – can be incorporated in the framework of reinforcement learning theories, via algorithms for "model-based" learning. These considerations extend learned decision making beyond its home territory in striatum, suggesting interactions with regions involved in declarative and episodic learning. Next, I discuss experiments designed to characterize these influences on decision behavior and associated neural signals. By fitting computational models to human decision behavior and BOLD signals, we demonstrate that neither choices nor putatively dopaminergic signals in striatum can be explained by past reinforcement alone, but instead that both reflect additional declarative learning about task structure and contingencies. Further analyses and experiments seeking trial-by-trial correlates of this structural learning point to regions in the medial temporal lobe and prefrontal cortex. I consider the ramifications of these results for the interactions between procedural and declarative memory systems.

Symposium Session 5

Tuesday, April 20, 1:00 - 3:00 pm
Westmount Ballroom

WHAT CONTROLS EXECUTIVE CONTROL? THE INFLUENCE OF 'CONTROL CONTEXT'

Tuesday, April 20, 1:00 - 3:00 pm, Westmount Ballroom

Chair: Amishi Jha, University of Pennsylvania

Speakers: Tobias Egner, Amishi Jha, Jonas Perrson, Michael Inzlicht

Executive control functions (EF) refer to a family of processes needed to successfully perform complex tasks, particularly in rapidly-changing or demanding situations. Yet, very little is known about the reciprocal influence that situational demands, themselves, may have on executive control. Rather than implicating a homunculus, who sits patiently deciding if control should be up- or down-regulated, a comprehensive account of EF must clarify which factors influence the dynamic engagement or withdrawal of specific control functions. Past studies using response conflict tasks find that when prior control demands are high, subsequent performance improves relative to when prior demands were low. Are these patterns exclusive to conflict tasks, or are they observable across a variety of EF contexts? In studies investigating cognitive fatigue, continued use of specific control processes leads to subsequent performance failures on EF tasks engaging those processes. How might fatigue effects differ for management of 'cold' vs 'hot' demands? We investigate these questions across several EF tasks. Our behavioral, fMRI, and ERP results collectively suggest that the 'control context', which we characterize as the type, level, and duration of prior demands on executive control, significantly influences subsequent deployment of EF across a variety of task contexts.

ABSTRACTS

CONFLICT-SPECIFIC ADAPTATION PROCESSES IN THE HUMAN BRAIN Tobias Egner[1]; [1]Duke University — Cognitive control describes the ability to flexibly configure, maintain, and adjust sets of processing strategies (task-sets) in the pursuit of internal goals. This ability has traditionally been ascribed to a central executive resource that can orchestrate mnemonic, attentive, sensory, and motor processes in line with task demands. More recently, researchers have begun to fractionate this monolithic entity, to replace this quasi-homunculus with a collection of explicitly defined component processes or mechanisms that, in collaboration, may give rise to behavioral flexibility. One such component is a conflict-driven regulatory mechanism for task-set maintenance (conflict adaptation) that employs processing conflicts as a signal for reinforcing the top-down biasing processes that comprise a current task-set. I will discuss the cognitive and neuroanatomical architecture of conflict adaptation in human subjects. I will present evidence that, rather than being a single, domain-general mechanism, conflict adaptation represents a collection of multiple independent conflict-control loops that resolve different types of conflict.

WORKING MEMORY DEMANDS TRIGGER DYNAMIC ADJUSTMENTS IN EXECUTIVE CONTROL Amishi Jha[1], Anastasia Kiyonaga[1]; [1]University of Pennsylvania — Dynamic adjustments in executive control are well-documented in 'conflict' tasks, wherein competition from irrelevant stimulus attributes intensifies selection demands and leads to subsequent performance benefits. We investigated if mnemonic demands, in a working memory (WM) task, could similarly drive online control modifications. Demand levels (High vs. Low) of WM maintenance (memory load of 2 items vs. 1) and delay-spanning distractor interference (confusable vs. not confusable with memoranda) were manipulated using a factorial design during a WM delayed-recognition task. In young adults, performance was best subsequent to trials in which both maintenance and distractor interference demands were high, followed by trials with high demand in either one of these two control domains, and worst following trials with low demand in both domains. FMRI results revealed that activity within subregions of prefrontal cortex (PFC) was sensitive to demand levels for both the previous and current trial. Since age-related changes in PFC are well-documented, we investigated if performance patterns vary over the lifespan. Indeed, demand-triggered benefits in task performance became more robust from late adolescence into young adulthood, and degraded with advancing age. In adolescents, greater context-sensitive adjustments corresponded with better academic achievement. Thus, behavioral and neural measures, as well as real-world performance outcomes, suggest that dynamic adjustments in executive control may be a potent mechanism by which the WM system configures itself for successful task performance.

TRAINING AND DEPLETION OF EXECUTIVE FUNCTIONS: THE CASE OF INTERFERENCE CONTROL Jonas Perrson[1], Patricia Reuter-Lorenz[2]; [1]Stockholm University, [2]University of Michigan — Brain imaging reveals overlapping sites of prefrontal activation for different cognitive tasks suggesting they may share core executive processes. We tested this hypothesis by measuring behavioral interactions between memory tasks presumed to require interference control - a putative executive process that mediates selection from competing representations. Behavioral data show that different training regimens produce either negative or positive transfer from working memory to semantic and episodic memory task performance. We show that eight days of training on high interference versions of three different working memory tasks increased the efficiency of interference control on the training tasks and on untrained tasks in new memory domains. In contrast we have also demonstrated negative transfer and process-specific "fatigue" effects indicating that control efficiency in a second task is diminished by high control demands in a prior task immediately preceding it in time. This suggests that interference control is a finite resource that can be temporarily depleted. Functional magnetic resonance imaging (fMRI) was used to elucidate the mechanisms associated with decreasing efficiency or resource depletion of the interference control process. Along with reduced performance, fMRI indicates negative transfer is associated with reduced process-specific activation, and increased homologous activation that may be compensatory. In sum, this suggests that interference control is an executive function that is both resource limited and plastic making it possible for training to alter its efficiency.

REGULATORY FATIGUE: NEUROPHYSIOLOGICAL EVIDENCE THAT FATIGUE AFFECTS EXECUTIVE CONTROL AND EMOTIONAL RESPONDING Michael Inzlicht[1], Jennifer Gutsell[1]; [1]University of Toronto — Past research indicates cognitive control is limited, depleting quickly after initial exertions. Here, we examine the why and how of fatigue by examining its neurocognitive and emotional/motivational sequelae. In Study 1, participants watched an emotional movie while instructed to either suppress their emotions or watch normally, and then completed an ostensibly unrelated Stroop task while EEG was recorded. Results indicate that emotional suppression impaired Stroop reaction-time performance, an effect mediated by a lower error-related negativity (ERN)—a neural waveform generated by the anterior cingulate cortex and thought to index aspects of the conflict monitoring system. In Study 2, participants watched a video of a person being interviewed while distracting words appeared at the bottom of the screen; participants were instructed to ignore the words or to watch normally. They then viewed positive, negative, and neutral IAPS images within which were embedded 50 ms startle auditory probes while their startle-blink response was measured with EMG. Results suggest that cognitive suppression dampened both the strength of subsequent emotional reactions and emotional differentiation due to valence. Taken together, the results of both studies offer a neural mechanism for cognitive fatigue and suggest an important place for emotion in executive control.

Slide Session 1

Saturday, April 17, 3:00 - 5:00 pm
Westmount Ballroom

EMOTION AND SOCIAL COGNITION

Chair: Kevin Ochsner, Columbia University

Speakers: Joshua M. Susskind, Mara Mather, Julie L. Hall, Hedy Kober, Jennifer S. Rabin, Grit Hein, Molly Crockett, Bradley Thomas

A B S T R A C T S

OPPONENT CODING OF EMOTIONAL FACIAL CATEGORIES Joshua M. Susskind[1], Adam K. Anderson[1]; [1]University of Toronto — Following Darwin's early observations (Darwin, 1872), it is now widely thought that facial expressions are recognized in relation to one of six or more independent prototypes, with cross cultural, neuroimaging, and neuropsychological studies supporting these prototypes as the fundamental building blocks of emotional representation. However, Darwin's original thesis was that emotional expressions are not distinct but rather are derived from opposing pairs for efficient social transmission. Here we provide evidence for such an opponent coding model of facial expression appearance and perception. Employing a computational model to form a multidimensional face space representing contrasting facial actions, we examine both behavioral and neural indices of opponent coding predicted by the model. First we examine model and human emotion judgments and demonstrate that visual-statistical opposites of expressions (i.e., emotional anti-faces) signal opposing emotions. Second we show that contrasting emotional expressions cancel each other's appearance, nullifying subjective intensity judgments and objective discrimination measures of expression perception. Third we show that comparing physically opposing emotional expressions enhances discrimination. Finally, we examine neural indices of opponent coding and show that adapting to an expression results in opposing afterimages in an identical test stimulus, biasing perception of the center of expression space toward its opposite. These converging sources of evidence suggest that facial expressions are not distinct, but rest upon underlying opposing contrasts encoded via opponent neural representations, similar to that of basic perceptual attributes such as color and motion, serving to enhance detection of deviations from neutral states.

STRESSED MEN AND WOMEN PROCESS FACES DIFFERENTLY Mara Mather[1], Nichole R. Lighthall[1], Lin Nga[1], Marissa A. Gorlick[1]; [1]University of Southern California — Under stress, men tend to withdraw socially while women seek social support. In the current study, we examined whether these sex differences in social behavior under stress extend to one of the most basic social transactions: face processing. Participants assigned to the stress group were asked to hold their hand in ice water for three minutes (control participants held their hand in warm water). This stress manipulation increased cortisol levels. During the period of post-stress elevated cortisol, we conducted a 3 T functional magnetic resonance imaging scan of participants while they viewed angry and neutral faces. Participants also completed a separate face localizer scan. We found that fusiform face area (FFA) response to faces was diminished by acute stress in males but increased by stress in females. Furthermore, in stressed males looking at angry faces, the insula showed reduced coordination with the FFA and the amygdala, but the inverse was true in stressed females. The insula plays a key role in mirroring the emotions of others and helps us understand what others feel. Thus, our findings that stress reduces insula involvement in brain networks that process emotional expressions in males but increases insula involvement in those same networks in females have important implications for social interactions and empathy under stress.

UNCONSCIOUS AFFECT AND ECONOMICS BEHAVIOR: FMRI EVIDENCE FOR STRONGER UNCONSCIOUS THAN CONSCIOUS AFFECTIVE INFLUENCES ON FINANCIAL CHOICES Julie L. Hall[1], Richard Gonzalez[1], Chandra Sripada[1], Oliver C. Schultheiss[2]; [1]University of Michigan, [2]Friedrich-Alexander University — Traditionally, the dominant method of measuring affect in psychological research has been through the use of explicit, self-report measures. More recently, implicit, unconscious measures have been developed to assess emotions that respondents may not be consciously aware of or able to report. The current study provides evidence for stronger unconscious than conscious affective influences on financial choices. Using fMRI, 24 participants viewed happy, angry, and neutral affective primes presented under subliminal and supraliminal conditions followed by an investment task where they had to decide between risky, high-payoff stocks and safe, low-payoff bonds. Our results indicate that both subliminal and supraliminal presentations of affective primes influence financial investment decisions and anticipatory neural activation in the nucleus accumbens. As predicted, participants showed greater nucleus accumbens activation and made more risky investment decisions after happy versus neutral face primes, an effect that was significantly stronger for subliminal versus supraliminal primes. Furthermore, implicit measures of positive affect were associated with more nucleus accumbens activation and risky investment decisions and implicit measures of negative affect were associated with more safe bond choices; on the other hand, explicit measures of positive and negative affect had no effect on financial choices or anticipatory neural activation. In conclusion, our results demonstrate that affect influences financial investment decisions and neural markers of anticipatory arousal, particularly at an unconscious level.

PREFRONTAL-SUBCORTICAL PATHWAYS MEDIATING SUCCESSFUL REGULATION OF CRAVING IN CIGARETTE SMOKERS Hedy Kober[1,2], Peter Mende-Siedlecki[3], Ethan Kross[4], Jochen Weber[2], Walter Mischel[2], Carl Hart[2,5], Kevin Ochsner[2]; [1]Yale University, [2]Columbia University, [3]Princeton University, [4]University of Michigan, [5]New York State Psychiatric Institute — Substance use disorders are chronic relapsing conditions that represent a societal problem with staggering social costs. Drug craving has long been considered a primary contributor to drug use, and the inability to regulate it is thought to be at the root of compulsive drug-taking behavior. Although the neural systems underlying drug craving have been described, this work has yet to make contact with research on the neural systems supporting the ability to regulate emotion. We bridged this knowledge gap to examine neural activity in the most prevalent substance abusing population in the US – cigarette smokers – as they used cognitive strategies to regulate craving for cigarettes and food. We previously reported that the cognitive down-regulation of craving was associated with activity in regions previously associated with regulating negative emotion including dorsomedial, dorsolateral, and ventrolateral prefrontal cortex. This was accompanied by decreased activity in regions previously associated with craving, including the ventral striatum (VS), subgenual cingulate, amygdala, and ventral tegmental area. Here we report that decreases in craving correlated with decreases in VS activity and increases in DLPFC activity. Importantly, VS activity fully mediated the relationship between dlPFC and reported craving. These results provide insight into the mechanisms that enable cognitive strategies to effectively regulate craving, suggesting that it involves neural dynamics parallel to those involved in regulating other emotions. In so doing, this study provides a methodological tool and conceptual foundation for studying this ability across substance abusing populations and developing more effective treatments for substance use disorders.

DEGREE OF FAMILIARITY WITH SITUATIONS AND PEOPLE INFLUENCES THE FUNCTIONAL OVERLAP BETWEEN THEORY OF MIND AND AUTOBIOGRAPHICAL MEMORY. Jennifer S. Rabin[1], R. Shayna Rosenbaum[1,2]; [1]York University, [2]Rotman Research Institute — Neuroimaging studies find that overlapping and unique brain regions underlie autobiographical memory (AM) and theory of mind (ToM). Investigations of people who lack AM but have intact ToM suggest a dissociation between these abilities; however, this is based on standard ToM tasks that may not induce simulation processes due to their impersonal nature. Greater functional overlap is expected between AM and ToM in known situations involving familiar people that may facilitate simulation of another's mental state. Here, we aimed to clarify the functional relationship between AM and ToM by varying the degree of personal experience with the protagonist in the ToM condition. Participants were scanned as they remembered past experiences in response to personal photos (AM condition) and imagined others' experiences in response to photos of personally familiar (friends and relatives, i.e., personal ToM condition; pToM) and unfamiliar people (i.e., impersonal ToM condition; iToM). Analyses revealed common activity within bilateral medial-temporal lobes, medial prefrontal cortex (PFC), posterior cingulate/retrosplenial cortex, left ventrolateral PFC, and left middle temporal gyrus in all three conditions. Functional overlap was greatest during AM and pToM. Furthermore, AM and pToM elicited greater activation of medial PFC and posterior regions relative to iToM, whereas pToM and iToM elicited greater activation of lateral temporal, left ventrolateral PFC, and temporal-parietal regions relative to AM. These data suggest that ToM tasks involving familiar people may induce simulation processes that draw on the same neural network as AM and that disruption to this network may lead to both AM and ToM compromise.

INGROUP BIAS IN NEURAL EMPATHY PREDICTS INGROUP FAVORITISM IN COSTLY HELPING Grit Hein[1], Giorgia Silani[1], Kerstin Preuschoff[1], Daniel C. Batson[2], Tania Singer[1]; [1]Laboratory for Social and Neural Systems Research, University of Zürich, [2]Department of Psychology, University of Kansas — Often, people are more willing to engage in prosocial behavior towards "their people" than members of a different group, causing serious social conflicts. Here, we provide a neurobiological mechanism for ingroup favoritism in helping behavior. We measured the brain responses of soccer fans while they watched either a fan of their own favorite team (ingroup member) or a fan of a rival team (outgroup member) suffering pain. In a second session, scanned participants were given the opportunity to decide, among other options, whether to help the ingroup and outgroup member by opting to endure half of their pain themselves. Thus, helping was costly because it entailed receiving a moderately painful shock. Participants' empathic brain responses in left anterior insula were greater when they saw an ingroup, as compared to an outgroup, member suffering. The extent of this ingroup bias in empathic brain responses predicted participants' degree of ingroup favoritism in subsequent helping. Moreover, participants with a negative impression of the outgroup member showed nucleus accumbens (NAcc) activation instead of empathic responses in anterior insula, when they saw an outgroup member in pain. The strength of the signal in NAcc -previously linked to Schadenfreude- was correlated with reduced helping of the outgroup member. These findings stress the importance of cultivating empathy for outgroup members in order to counteract ingroup favoritism and to promote prosocial behavior towards all human beings.

NEUROCHEMICAL MODULATION OF HUMAN PROSOCIAL BEHAVIOR AND MORAL JUDGMENT (GSP WINNER) Molly Crockett[1], Luke Clark[1], Marc Hauser[2], Trevor Robbins[1]; [1]University of Cambridge, [2]Harvard University — Studies on the neural basis of human morality suggest that our ability to "know" right from wrong arises from mechanisms distinct from those that enable us to "feel" right from wrong and guide our social behavior appropriately. In the current study, we differentially manipulated moral judgment and prosocial behavior in healthy volunteers by altering neurotransmitter function with citalopram, which boosts serotonin function, and atomoxetine, which augments prefrontal noradrenaline and dopamine function. We administered citalopram, atomoxetine, and placebo on three separate occasions to 30 healthy volunteers in a double-blind, placebo-controlled, fully counterbalanced crossover design. Ninety minutes following drug administration, volunteers played several one-shot ultimatum games, in which they decided whether to accept or reject fair or unfair monetary offers from another player, and judged a standard set of moral dilemmas that included emotion-provoking 'personal' moral scenarios, less emotional 'impersonal' moral scenarios, and non-moral control scenarios. Citalopram increased prosocial behaviour in the ultimatum game, relative to both atomoxetine and placebo, but atomoxetine had no effect on prosocial behaviour. Meanwhile, atomoxetine and citalopram had distinct effects on moral judgment: relative to placebo, atomoxetine reduced the likelihood of judging both personal and impersonal harms as permissible, while citalopram reduced only the likelihood of judging personal moral harms as permissible. Finally, across individuals the tendency to reject unfair offers in the ultimatum game was significantly correlated with the tendency to judge personal, but not impersonal harms as permissible. These results support the notion of distinct neural mechanisms for moral judgment and prosocial behaviour.

THE INSULA IN POLITICAL JUDGMENT Bradley Thomas[1], Daniel Tranel[1], Michael Alvarez[2], Kyle Mattes[1], Ralph Adolphs[2], Michael Spezio[2]; [1]University of Iowa, [2]Caltech — Social judgments made solely on the basis of a candidate's visual appearance correlate with real-world election outcomes (Todorov et al., 2005). We previously showed that this effect is associated with regional activation of the insula during such judgments, and in particular that the insula is more activated when viewing people who lost real elections, especially when participants are primed to process threat-related information (Spezio et al., 2008). Here we investigated the causal role of the insula with a lesion study. Using the same stimuli and tasks as in our prior study (Spezio et al., 2008), we tested 12 individuals with focal lesions to the insula. The insula-lesioned group showed normal age judgments of the faces that were associated with real-world election wins, as is the case in healthy individuals ($t=2.6$; $p<0.02$). They also showed a trend association with real-world elections when asked to carry out a simulated vote ($t=1.5$, $p=0.08$). However, whereas healthy individuals show a robust association of real-world election outcomes with ratings of competence (positively) and threat (negatively), the insula-lesioned group showed neither effect ($t=-0.67$, $p=0.3$ for threat; $t=0.54$, $p=0.3$ for competence). The findings suggest that the insula is required for threat-related cues from a candidate's appearance to influence election outcomes.

Slide Session 2

Saturday, April 17, 3:00 - 5:00 pm
Outremont Ballroom

THINKING & DECISION MAKING

Chair: Kalina Christoff, University of British Columbia

Speakers: Carolyn Parkinson, Vinod Venkatraman, Stephen Fleming, Roi Cohen Kadosh, Rachael Grazioplene, Melissa Ellamil, Rebecca Charlton, R. Nathan Spreng

A B S T R A C T S

IS MORALITY UNIFIED? THE NEURAL CORRELATES OF DIFFERENT KINDS OF MORAL JUDGMENTS (GSP WINNER) Carolyn Parkinson[1], Walter Sinnott-Armstrong[1], Thalia Wheatley[1]; [1]Dartmouth College — Researchers have recently begun to investigate moral judgment using neuroscientific techniques. By and large, these studies have been designed assuming that morality is sufficiently unified to be studied as a single kind of judgment. However, scholars in other fields (e.g., philosophy, anthropology) have posited that there are multiple distinct domains of morality. The current study used functional imaging to examine the neural correlates of the judgment of 3 categories of moral transgressions: dishonest, disgusting and harmful acts. 40 naïve, right-handed adults were scanned in a 3.0-Tesla Phillips scanner. While in the scanner, subjects read 14 morally ambiguous scenarios from each of 3 moral categories (disgust, dishonesty, harm), as well as 14 neutral scenarios. After reading each scenario, subjects used a button press to indicate whether the act described was morally ‘wrong’ or ‘not wrong.’ Judgments of moral transgressions that evoked disgust elicited increased activity in the insula, amygdala, and cingulate cortices. The judgment of dishonest acts was correlated with increased bilateral activity in the temporoparietal junction, while judgment of physically harmful acts was correlated with increased activity in the inferior parietal lobule, insula, precuneus and posterior cingulate. These results contrast with those of past studies that have lumped so-called ‘moral judgments’ together, and suggest that judgments of moral scenarios involving different kinds of transgressions draw on disparate neural and cognitive mechanisms. Thus, future studies should differentiate between subsets of moral judgments, and identify factors that unify and distinguish them from one another.

MECHANISMS UNDERLYING STRATEGIC VARIABILITY IN ECONOMIC DECISION MAKING Vinod Venkatraman[1], John W. Payne[1], Michael W.L. Chee[2], Scott A. Huettel[1]; [1]Duke University, [2]Duke-NUS Graduate Medical School, Singapore — Adaptive decision making involves the use of multiple strategies that vary with decision context, both within and across individuals. In a series of behavioral, eye-tracking and fMRI experiments using an economic decision-making task, we sought to understand the mechanisms underlying strategic variability in risky choice. In each trial, participants were provided with a three- or five-outcome mixed gamble consisting of at least one monetary gain, one monetary loss and one intermediate outcome that was typically $0 or slightly negative. They could make three types of choices: gain-maximizing (increasing the magnitude of largest gain), loss-minimizing (decreasing the magnitude of worst loss) or probability-maximizing (increasing overall probability of winning by modifying valence of intermediate outcome). Across multiple studies, we demonstrated a systematic bias towards probability-maximizing choices. Individual differences in the extent of this bias correlated positively with a satisficing trait, negatively with a sadness trait, and could be predicted using patterns by which information about the gambles was acquired (indexed using eye positions). We also show that strategic preferences can be modified using subtle variations in the decision context, as well as following 24 hours of total sleep deprivation. Finally, using fMRI, we demonstrate that distinct neural systems were associated with choices and with strategic preferences across individuals. Moreover, changes in these neural systems predicted an increased bias toward gain-maximizing choices following sleep deprivation. Our findings highlight individual variability in strategic preferences as a key direction through which neuroscience data can influence models of risky choice.

CIRCUITS FOR OVERCOMING DECISION INERTIA IN THE HUMAN BRAIN Stephen Fleming[1], Charlotte Thomas[2], Raymond Dolan[1]; [1]University College London, [2]University of Bristol — Humans often accept the status quo, or default, when faced with conflicting choice alternatives. However, it is unclear how neural pathways linking cognition and action contribute to such decision inertia. To examine this question, we used a visual detection task where decision difficulty and the default response option were systematically and independently manipulated within a factorial design. We show that subjects tend to accept a default when making difficult, but not easy, decisions. This bias was suboptimal in that more errors were made when the default was accepted. Using functional magnetic resonance imaging (fMRI) we show that an interaction between decision conflict and default acceptance was uniquely expressed in enhanced activity in bilateral regions that encompass the subthalamic nuclei (STN). These findings suggest a specific role for STN activity in overcoming conflict-induced decision inertia. Consequently, to reveal the mechanism driving this effect we employed an effective connectivity analysis to show that right inferior frontal cortex is both sensitive to conflict and modulates the STN, contributing to decision inertia. Importantly, a driving influence of right inferior frontal cortex on the STN was increased during rejection of the default, supporting a role for this pathway in overcoming a status quo bias. We conclude that overcoming inertia during difficult decisions invokes specific neural dynamics within prefrontal-basal ganglia circuitry, suggesting commonalities between the neural mediation of the status quo bias in healthy individuals and decision inertia induced by pathologies of movement.

BRAIN STIMULATION TO THE PARIETAL AND DORSOLATERAL PREFRONTAL CORTICES REVEALS DOUBLE DISSOCIATION BETWEEN LEARNING AND AUTOMATICITY Roi Cohen Kadosh[1], Sonja Soskic[2], Teresa Iuculano[2], Ryota Kanai[2], Vincent Walsh[2]; [1]University of Oxford, [2]University College London — How do we learn to encode and represent numerical information? What are the necessary brain mechanisms underlying such abilities? Cognitive, neuropsychological, and anthropological studies show that intact and proficient numerical representation is characterised by: 1) automatic retrieval of numerical quantity, and 2) interactions between number and space, such as for example accurate mapping of numbers on a physical line. We examined here how non-invasive brain stimulation (transcranial direct current stimulation (tDCS)) of the right dorsolateral prefrontal (DLPFC) and the right posterior parietal (PPC) cortices over 6 days of numerical learning affects: 1) the efficiency of learning of a new numerical system, 2) the development of its automaticity, and 3) the interaction between newly learnt numbers and space. The current results revealed a double dissociation between the DLPFC and the PPC. The DLPFC was crucial for numerical learning, while the PPC was necessary for the acquisition of automatic numerical quantity and its interaction with space. These effects were specific to the learning of a new numerical system as brain stimulation did not affect the automaticity and the mapping of numbers into space of everyday digits. These results challenge the idea that automaticity is a result of effective skill acquisition. Furthermore, they question the necessity of the DLPFC in symbolic numerical representation, and have implications for models of typical and atypical numerical development.

CRITICAL CONNECTIVITY: A NEUROBIOLOGICAL THRESHOLD EFFECT FOR CREATIVE ABILITY Rachael Grazioplene[1], Robert S. Chavez[1], Alison Marshall[1], Ranee A. Flores[1], Rex E. Jung[1]; [1]The Mind Research Network — The threshold theory of creativity posits that intelligence predicts performance on divergent thinking tasks, but only up to an IQ of about 120 (Runco and Albert, 1986). However, a meta-analysis casts doubt on the validity of the threshold effect (Kim, 2005). These contradictory behavioral findings might be refined if we understand the relationship between brain architecture and creativity measures at different IQ levels. Therefore, we hypothesized differential white matter-behavior relationships in subjects below an IQ of 120 compared to those above 120. A group of healthy normal volunteers (n=100, ages 18-29) underwent cognitive testing and structural MRI scanning at 3 Tesla. Based on the mean Full-Scale Intelligence Quotient (FSIQ) of 119, the sample was split into 2 groups for analysis (Lower Group<120, n=47; Higher Group>=120, n=53). Behaviorally, FSIQ conformed to a linear relationship with divergent thinking scores in the Lower FSIQ Group ($r=0.32$, $p<0.05$), but not in the Higher FSIQ Group. Voxel-wise cross-subject statistical analyses showed a strong inverse correlation between frontal white matter fractional anisotropy (FA) and composite divergent thinking scores in the Higher FSIQ Group (clusters significant at p=0.01-0.001); no such relationship approached significance in the Lower Group. This finding suggests that lower white matter coherence in frontal thalamo-cortical white matter may confer cognitive advantages for divergent thinking abilities, but only in conjunction with intelligence levels in the superior range and higher (FSIQ >120).

SPONTANEOUS AND DELIBERATE MODES OF THOUGHT DURING THE CREATIVE PROCESS Melissa Ellamil[1], Charles Dobson[2], Mark Beeman[3], Kalina Christoff[1]; [1]University of British Columbia, [2]Emily Carr University of Art and Design, [3]Northwestern University — Until recently, neuroscientific investigations of human thought equated it with only the deliberate, goal-directed mental processes that occur during problem solving, while spontaneous mental processes (e.g., mind wandering) occurring without direct control have been overlooked. The creative process appears to combine both modes of thinking: the generation of novel ideas is facilitated by low cognitive control and defocused attention that characterize spontaneous thought, while the evaluation of those ideas is aided by high cognitive control and focused attention that characterize deliberate thought. Deliberate thought has been linked to the brain's executive network, while spontaneous thought seems to activate the default network. However, both modes of thought have so far not been examined within the same study, and their neural correlates remain unclear. The study used a creativity task during functional magnetic resonance imaging (fMRI) to examine neural recruitment during spontaneous and deliberate modes of thought in the context of creative production. Using an fMRI scanner-compatible drawing tablet, students from a local arts college alternated between generating ideas for a book cover, evaluating the ideas generated, and tracing over lines that appeared on the screen (baseline). Generation was associated with activations in the default (parahippocampus) and executive (ventrolateral prefrontal cortex [PFC]) networks. Evaluation was also associated with activations in the default (medial PFC, posterior cingulate cortex/precuneus) and executive (dorso/rostrolateral PFC, dorsal anterior cingulate cortex) networks. Thus, in the context of creative production, spontaneous and deliberate modes of thought demonstrate parallel recruitment of two neural networks thought to work in opposition.

WHITE MATTER PATHWAYS ASSOCIATED WITH VERBAL EPISODIC AND WORKING MEMORY, MEASURED USING TRACT-BASED SPATIAL STATISTICS IN NORMAL AGING Rebecca Charlton[1], Thomas Barrick[1], Hugh Markus[1], Robin Morris[2]; [1]St George's University of London, [2]Institute of Psychiatry, King's College London — Diffusion tensor imaging (DTI) is sensitive to loss of white matter integrity in normal aging. Using whole brain measurements and large regions of interest, DTI has been shown to correlate with both verbal working (WkM) and episodic memory (EM). The impact of changes in white matter integrity on the networks that support these functions remains unclear. It has been suggested that these memory abilities utilise common frontal grey matter regions, but also unique grey matter in the parietal (WkM) and temporal (EM) lobes. To explore this further tract based spatial statistics (TBSS), which allows 3D investigation of white matter tracts, was performed on 98 middle-aged and older adults. White matter tracts were identified that were associated with variations in WkM and EM in the frontal lobes bilaterally. In addition, verbal WkM was associated with white matter pathways in the left parietal lobe, whereas verbal EM was associated with bilateral temporal pathways. The results support the notion that damage to certain white matter pathways may have widespread effects on different cognitive abilities by causing disruption to multiple distributed networks. In addition, certain abilities may be more affected by damage to specific tracts, because tract disruption has specific effects on a unique network.

LEVELS OF DIFFICULTY IN AUTOBIOGRAPHICAL AND VISUOSPATIAL PLANNING DIFFERENTIALLY MODULATE CORE, DORSAL ATTENTION AND CONTROL NETWORK ACTIVITY R. Nathan Spreng[1], Adrian W. Gilmore[1], Daniel L. Schacter[1]; [1]Harvard University — Planning is an adaptive function that guides complex everyday behavior. We recently reported a novel autobiographical planning (AP) task where participants were given a goal state and integrated three component steps into a personal plan to fulfill that goal. We found that AP engaged the core network, including frontal and posterior midline structures, medial and lateral temporal lobes and posterior inferior parietal cortex. Visuospatial planning, as measured by the Tower of London (TOL) task, engaged the dorsal attention network, including dorsolateral prefrontal cortex, frontal eye fields, intraparietal sulcus, and ventral occipital cortex. Relative to a counting task, both planning tasks engaged the frontoparietal control network (FPCN), including rostrolateral prefrontal cortex, anterior cingulate, and anterior inferior parietal cortex. To assess the impact of task demands on this pattern of activity, we examined changes in BOLD signal, using fMRI in 25 participants, associated with parametrically modulating the difficulty of both autobiographical and TOL planning. Compared with easy trials, difficult AP trials required the integration of more steps and difficult TOL trials required more moves to reach a solution. Easier AP elicited greater activity in the core network than difficult AP. TOL difficulty modulated the magnitude of dorsal attention network activity, consistent with previous reports. The FPCN was engaged in both planning tasks. However, easier AP engaged the FPCN less than difficult AP. TOL task difficulty did not modulate FPCN activity. These findings expand our understanding of the functional interaction between the FPCN and the core and dorsal networks related to task demands.

Slide Session 3

Sunday, April 18, 10:00 am - 12:00 pm
Outremont Ballroom

LANGUAGE

Chair: Tamara Swaab, University of California, Davis
Speakers: Kristof Strijkers, Kalinka Timmer, Karin Harman James, Marina Bedny, Jeremy Skipper, Amit Almor, Chantel Prat, Raymond Mar

ABSTRACTS

TEMPORAL ERP EVIDENCE FOR AN EARLY DISSOCIATION BETWEEN SEMANTIC AND LEXICAL REPRESENTATIONS IN FUNCTION OF TASK DEMANDS (GSP WINNER) Kristof Strijkers[1,2], Phillip Holcomb[3], Albert Costa[2]; [1]Universitat Pompeu Fabra, Spain, [2]Universitat de Barcelona, Spain, [3]Tufts University — Most models on object processing and naming posit that activation automatically cascades from semantic processing to lexico-semantic and, according to some, word form representations. Given this continuous transmission of information, top-down processing in function of task demands and context should at some point in time gate the flow of activation towards those representations relevant for response execution. However, very little is known about how and especially when top-down task demands affect bottom-up object processing. Based on recent findings showing early lexical ERP modulations (~ 175 – 200 ms) in overt naming tasks (Strijkers et al., 2009; Costa et al., in press), we compared the time-course of processing during overt picture naming (experiment 1) with that of go/no-go semantic categorization (experiment 2), assuming that only naming requires fast lexical activation. In order to obtain a reliable measure of access to the object's name, lexical frequency was manipulated. During overt naming, low frequency ERPs diverged from high frequency ERPs very early on (~ 175 ms), replicating recent findings. Importantly, during semantic categorization of the same objects, low frequency and high frequency ERPs did not yield any early modulations. These results offer strong additional evidence that the brain rapidly accesses the lexical system after perceiving a picture; however, the fast lexical engagement only occurs when actual naming is required. This is the first direct on-line demonstration for an early functional dissociation between the semantic and lexical systems, with top-down task demands shaping bottom-up activation earlier as expected by most theories.

THE TIME COURSE OF ORTHOGRAPHY AND PHONOLOGY DURING READING ALOUD IN A SECOND LANGUAGE: EVIDENCE FROM AN ERP STUDY Kalinka Timmer[1,2], Niels O. Schiller[1,2]; [1]Leiden University, [2]Leiden Institute for Brain and Cognition — This study confirmed that the Masked Onset Priming Effect (MOPE), which is often found in primary language usage, can also be observed in a second language. Bilingual Dutch-English participants read aloud English words starting with phonologically ambiguous letters (e.g. /c/, carpet or cigar) or with phonemes that have multiple orthographies (e.g. /f/, phase or fellow) in a masked priming experiment to separate the contribution of orthographical and phonological activation in reading aloud. Orthographical priming was found in early time windows of event-related potentials (ERPs), even if it did not affect the overall reaction times. Phonological priming, on the other hand, shortened the response time and was weakly indicated in later time windows of ERPs. Both the orthographic and phonological priming effects were present first for unambiguous onset words and later for ambiguous onset words, where the onset has multiple phonemic possibilities. These results show that non-native speakers, even if they speak with an accent (as they are accustomed to a different phonetic system) and even if they are less familiar to the orthography of their second language, behave in a similar way as native speakers.

THE EMERGENCE OF SENSORIMOTOR REPRESENTATIONS IN THE DEVELOPING BRAIN DURING LANGUAGE PROCESSING Karin Harman James[1], Shelley Swain[1], Harinder Kaur[1]; [1]Indiana University — In adults, verb perception recruits motor systems – we have recently shown that motor systems are also active when preschool children perceive verbs. Although the assumption is that our history of actions leads to this activation, until now, there has been no empirical evidence to support this claim. The present research uncovers experiences that are required for this motor recruitment to occur. Twelve children, aged 5-7 years, learned novel labels ('made-up' verbs) for actions performed with novel objects. Half of these labels were learned during 'active' interaction – the children manipulated the objects while the verb label was given, the other labels were learned 'passively' - while the children watched the experimenter demonstrate the actions. Subsequent to this experience, children heard all the novel verbs while BOLD activation was measured using fMRI. Results demonstrated that motor systems were recruited during 'verb' perception only after the participants learned the labels during active exploration. In contrast, no motor activation emerged when labels were learned by passively watching the experimenter during learning. These results demonstrate that verb perception recruits motor systems due to active involvement with objects. Language learning through active interaction with the environment results in representations that incorporate both motor and sensory systems in the developing brain.

LEFT OCCIPITAL CORTEX OF CONGENITALLY BLIND ADULTS RESPONDS TO GRAMMATICAL STRUCTURE Marina Bedny[1,2], David Feder[1], Evelina Fedorenko[1], Elizabeth Hawkins[1], Nancy Kanwisher[1], Alvaro Pascual-Leone[2], Saxe Rebecca[1]; [1]Massachusetts Institute of Technology, [2]Berenson-Allen Center for Noninvasive Brain Stimulation, Beth Israel Deaconess Medical Center, Harvard Medical School — In typically developing adults, language processing is supported by left prefrontal and lateral temporal cortices. In addition, to these brain regions, congenitally blind individuals activate parts of the left occipital cortex, including the primary visual cortices, during language tasks. The role of left occipital cortex in language processing is unclear. We studied the function of the left occipital cortices in three experiments with congenitally blind adults and sighted controls. In Experiment 1 congenitally blind and sighted participants listened to stories and answered true/false questions about them. In a control task, participants made a match/non-match judgment with backwards speech sounds. We found that the left occipital cortex responded more to sentences than backwards speech, despite the greater difficulty of the backwards speech task as measured by reaction time and accuracy. Experiment 2 showed that that left occipital cortex is not involved in retrieving word meanings: left occipital activity was not observed during a single-word comprehension task. Experiment 3 further examined the role of the left occipital cortex computing grammatical structure by comparing sentences, word lists, Jabberwocky sentences, lists of non-words and backwards speech. We found that left occipital cortex responded more to sentences than all other conditions and more to Jabberwocky sentences than to word lists, non-word lists and backwards speech. Word-lists, non-word lists and backwards speech conditions were not different from each other. We conclude that the left occipital cortices of congenitally blind adults are involved in constructing syntactic, sentence-level representations.

HOW THE BRAIN PREDICTS FORTHCOMING WORDS DURING SENTENCE LISTENING Jeremy Skipper[1], Jason Zevin[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University — In natural settings, listeners use sentence context to predict forthcoming discourse content. We propose that hypotheses about upcoming words are specified as motor commands that would be used to produce those words and that efference copy from the motor system predicts the occurrence of actual words. We tested this model using fMRI while participants listened to sentences that varied in final word predictability. High and low-predictability sentences were composed of a sentence frame, a filled pause of variable duration, and a final word. If listeners use sentence context to predict words, we expected "repetition suppression" of activity during the final word relative to the pause for high-predictability sentences in language comprehension areas. Indeed, anterior superior temporal cortex and the pars triangularis showed repetition suppression. Additionally, the spatial pattern of activity during the high-predictability pause was most correlated with the pattern of activity for the low-predictability final word in anterior superior temporal cortex only. Finally, if words were activated through efference copy from the motor system then activity during the high-predictability pause should occur in speech production areas. Indeed, inferior parietal, insula, and premotor cortex showed greater activity during the high compared to the low-predictability pause. Results suggest that the brain uses knowledge and expectations about sentence context to activate forthcoming words through efference copy from areas of cortex involved in speech production. We suggest that this predictive mechanism constrains interpretation and allows the brain to expend less time processing incoming sensory information, allowing resources to be allocated elsewhere.

THE NEURAL BASIS OF DEFINITE REFERENCE IN DISCOURSE – AN FMRI STUDY Amit Almor[1], Timothy Boiteau[1]; [1]University of South Carolina — Anaphoric reference is an important part of coherent discourse but very little is known about the brain basis of processing discourse anaphors. Much research in Linguistics and Psycholinguistics has indicated that anaphoric references to salient antecedents tend to employ more general expressions than the antecedent, often a pronominal form, but sometimes also a general category term. One intriguing finding about category anaphor processing is the Inverse Typicality Effect, which is the slower reading of a category anaphor (e.g., the bird) when referring to a salient antecedent, when that antecedent is a typical member of the category (e.g., robin) rather than an atypical one (e.g., chicken). This effect was previously argued to reflect increased working memory load caused by interference between the semantic representations of the category anaphor and of the salient typical member antecedent (Almor, 1999).

Here we used fMRI to test this claim by examining the brain regions that are differentially activated by discourses with category anaphors with salient typical antecedents, salient atypical antecedents, and non salient typical antecedents. We found that category anaphors with salient antecedents elicited greater activation with typical antecedents than with atypical antecedents in IFG bilaterally and in LH Fusiform Gyrus. The IFG activations are consistent with a WM involvement in the Inverse Typicality Effect while the Fusiform activations suggest that this effect also involves activations of lexical representation. The lack of activation differences between the conditions in other temporal regions suggests that the representations involved in this effect are lexical-semantic rather than conceptual-semantic.

A DIFFUSION TENSOR IMAGING INVESTIGATION OF INDIVIDUAL DIFFERENCES IN WHITE MATTER MICROSTRUCTURE AS A FUNCTION OF READING SKILL AND WORKING MEMORY CAPACITY Chantel Prat[1], Sarah Schipul[1], Timothy Keller[1], Marcel Just[1]; [1]Carnegie Mellon University — This study used diffusion tensor imaging (DTI) to investigate individual differences in the organization of white matter microstructure as a function of two behavioral measures of language ability. Associations of fractional anisotropy (FA) with indices of reading skill (Nelson-Denny Reading Test) and working memory capacity (Reading Span) were examined in a voxel-based multiple regression analysis of 73 healthy adults (40 males, aged 18-31). Both reading skill and working memory capacity (which were not correlated with one another) were positively correlated with FA, suggesting increased microstructural organization in higher-skilled and higher-capacity individuals. Higher reading skill was associated with increased FA in left hemisphere (LH) regions of superior longitudinal and inferior fronto-occipital fasciculi (connecting Broca's and Wernicke's areas) and in the anterior thalamic radiation (connecting thalamus to medial prefrontal regions). Higher working memory capacity was associated with increased FA in the forceps minor (connecting LH and RH frontal regions) and the cingulum (connecting the frontal, parietal, and temporal lobes). Increased FA in the LH of skilled readers may reflect increased myelination arising from more reading practice. Previous research has demonstrated such an increase in LH FA with intensive reading exposure (Keller & Just, in press). Increased FA in high-capacity individuals may speed information transfer between the frontal lobes, which are important for working memory and cognitive control, and the rest of the cortex, facilitating higher-level cognitive processes. These results show that systematic structural connectivity variations can be observed in healthy adults as a function of individual differences in cognition.

THE RELATIONSHIP BETWEEN STORY COMPREHENSION AND SOCIAL COMPREHENSION: QUANTITATIVE META-ANALYSES USING ACTIVATION LIKELIHOOD ESTIMATION Raymond Mar[1]; [1]York University — While initial neuroimaging investigations of language focused on lower-level word and syntactical representations, there has been a growing interest in investigating language at the level of discourse, particularly with respect to stories. One major question that has emerged is the relationship between story comprehension and social comprehension, with some hypothesizing that mental-inference processes are engaged while readers read about story characters and their interactions. Although some recent reviews have noted that the network of brain regions implicated during story comprehension resembles the social cognitive network, no review has directly compared the meta-analytic results for these two processes. Two quantitative meta-analyses were undertaken, employing the activation likelihood estimation (ALE) approach, for fMRI and PET studies of both narrative comprehension and mental inference. A total of 18 narrative comprehension articles were entered into the analysis, representing 22 samples, 293 participants, and 203 foci. For mental inference, 54 articles provided 55 samples, 712 participants, and 440 foci. Mental inference studies were further divided into those that employed stories as stimuli, and those that did not, with separate ALE meta-analyses performed for each group. Identifying the core social cognitive network was achieved by examining the overlap of these two groups, implicating the mPFC, bilateral TPJ, bilateral STS, posterior cingulate, and left IFG. The results for narrative comprehension overlapped with all of these areas, except for the posterior cingulate. While these results are consistent with the idea that mental inference is employed during narrative comprehension, other possibilities will be discussed.

Slide Session 4

Monday, April 19, 10:00 am - 12:00 pm
Outremont Ballroom

LONG-TERM MEMORY

Chair: Roberto Cabeza, Duke University

Speakers: Nina S. Hsu, W. Dale Stevens, Sarah Zweynert, Bradley Lega, Marie-France Marin, John Rudoy, Rebecca Spencer, David Maillet

A B S T R A C T S

FUNCTIONAL MAGNETIC RESONANCE IMAGING (FMRI) EVIDENCE FOR MULTIPLE COLOR KNOWLEDGE REPRESENTATIONS INFLUENCED BY CONTEXT AND COGNITIVE STYLE Nina S. Hsu[1], David J.M. Kraemer[1], Robyn T. Oliver[2], Margaret L. Schlichting[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania, [2]Roosevelt University — Numerous neuroimaging studies have supported sensorimotor theories of semantic memory by demonstrating overlap or proximity of brain regions sensitive to perception and knowledge retrieval. However, particularly within the domain of color knowledge, we hypothesize that some of the differences in results across studies may be due to the existence of multiple types of color knowledge representations. Moreover, retrieval of these representations can be influenced by both context and individual differences in cognitive style. In Experiment 1, we provide fMRI evidence for multiple representations of object color knowledge by having subjects perform a verbal task, in which context encouraged subjects to retrieve high- or low-resolution information about the colors of named common objects in a blocked experimental design. In the left fusiform, we found more activity during retrieval of high- versus low-resolution color knowledge. We also assessed preference for verbal or visual cognitive style, finding that brain activity in the left lingual gyrus significantly correlated with preference for a visual cognitive style. To eliminate the possibility that strategy accounts for the results, we conducted Experiment 2, which had a randomized design and quicker trials. We also removed the possibility of differential visual system engagement during viewing of written stimuli by presenting auditory stimuli instead. Experiment 2 replicated many of the findings of Experiment 1. Overall, these findings suggest the existence of multiple types of color knowledge representations that are based on resolution of detail, and that retrieval of these representations can be influenced by context and individual preferences in cognitive style.

ASYMMETRICAL RESTING-STATE FUNCTIONAL CONNECTIVITY OF PARAHIPPOCAMPAL CORTEX IS ASSOCIATED WITH LATERALITY DIFFERENCES FOR FORM-SPECIFIC VS. FORM-ABSTRACT REPETITION PRIMING OF SCENES W. Dale Stevens[1,2], Randy L. Buckner[1,2,3], Daniel L. Schacter[1,2]; [1]Harvard University, [2]Athinoula A. Martinos Center for Biomedical Imaging, [3]Howard Hughes Medical Institute — Behavioral priming refers to an improvement in performance upon successive encounters with the same or related stimuli, and is typically accompanied by reduced neural activity in specific cortical regions (neural priming). Neural priming reflects category-specificity, e.g., in bilateral scene-preferential parahippocampal cortex (SP-PHC) for repeated scenes. We recently reported functional asymmetry within SP-PHC: form-specific vs. form-abstract priming were lateralized within the right vs. left hemispheres, respectively, paralleling previous findings in other category-preferential visual regions, e.g., fusiform cortex for object-priming. Here, we tested the hypothesis that right/left differences are associated with differential functional connectivity of these regions with large-scale perceptual vs. conceptual networks, respectively. Bilateral SP-PHC regions were individually defined in healthy adults using independent functional localizers. Using resting-state functional connectivity analysis of fMRI data (rs-fcMRI) with a priori seed regions in middle occipital gyrus (MOG) and posterior inferior frontal gyrus (pIFG), we replicated two large-scale networks associated with perceptual- and conceptual-priming, respectively, as previously identified (Wig et al., 2009). We observed relatively increased correlation of right SP-PHC with the MOG/perceptual network, and of left SP-PHC with the pIFG/conceptual network. Whole-brain voxelwise analyses further demonstrated functionally-specific differential rs-fcMRI: Correlations were relatively higher for right SP-PHC with posterior and ventral visual regions and aspects of the dorsal attention network; and higher for left SP-PHC with regions of the default and frontoparietal control networks. Our results provide novel evidence that right/left form-specific vs. form-abstract priming asymmetry may be related to specialized differential functional connectivity of these regions with perceptual vs. conceptual large-scale networks, respectively.

EMOTIONAL SALIENCE DIFFERENTIALLY MODULATES REPETITION SUPPRESSION IN THE LATERAL AND MEDIAL VENTRAL VISUAL STREAM Sarah Zweynert[1,2], Torsten Wüstenberg[2], Kerstin Krauel[3], Constanze Seidenbecher[1], Emrah Düzel[3,4], Björn Schott[1,2,3]; [1]Leibniz Institute for Neurobiology, Magdeburg, Germany, [2]Charité University Hospital, Berlin, Germany, [3]Otto von Guericke University, Magdeburg, Germany, [4]University College London, London, UK — Repetiton suppression (RS) describes a decreasing neural response to stimuli as a function of their repeated presentation. Evidence from studies using faces as stimuli suggests that emotional salience modulates repetition effects in stimulus-related brain regions. Here we investigated the functional neuroanatomy of repetition effects and their emotional modulation in brain regions of the ventral visual stream using event-related functional MRI. 28 young healthy participants performed a simple visual working memory task in which targets and distracters (visual scenes) were presented repeatedly. Targets and distracters could either be neutral images or scenes with negative emotional (aversive) content. We hypothesized that in stimulus-related brain regions (e.g. Amygdala, parahippocampal place area (PPA), fusiform gyrus (FG)) repetition suppression would be stronger for emotional compared to neutral scenes. Both target pictures and task-irrelevant distracter pictures elicited a reliable repetition suppression response (1st – 3rd presentation) in ventral visual stream structures. Within these regions, we identified two separable patterns. In the amygdala and in the lateral fusiform cortex, emotional scenes showed significantly stronger initial brain responses and enhanced repetition suppression. In contrast, in the PPA, in the medial FG, and in the anterior hippocampus, repetition suppression was equally pronounced for emotional and neutral items. Our results suggest the presence of two distinct patterns of repetition suppression in the ventral visual stream, with a lateral portion showing emotional modulation of repetition effects and a medial portion that shows emotion-independent responses to repeated stimuli.

HUMAN HIPPOCAMPAL THETA OSCILLATIONS AND THE FORMATION OF EPISODIC MEMORIES Bradley Lega[1], Joshua Jacobs[1], Michael Kahana[1]; [1]University of Pennsylvania — Using data from neurosurgical patients undergoing invasive monitoring, investigators have demonstrated the functional importance of gamma oscillations in the cortex and hippocampus. Evidence for the importance of theta oscillations has been limited mostly to cortex. Select studies from the human literature suggest that the human correlate of the theta oscillation may be centered below 4 Hz. We present data from the largest existing database of patients with hippocampal depth electrodes performing free recall tasks. 33 patients with a total of 237 depth electrodes are included in this study. We employ a novel oscillation detection algorithm to identify theta oscillations. We identify an oscillation between 2.5 and 5 Hz and another located between 7.5 and 10 Hz. The lower frequency oscillation bears properties more in line with animal evidence of theta band activity. Using a subsequent memory effect analysis, we show that higher power in this frequency band is correlated with successful encoding of episodic memories. The effect matches the magnitude of the effect in the gamma band which has been previously documented. We note a concomitant negative SME, in which power during encoding is decreased for words that are subsequently recalled. The low theta SME was more specific in the dominant hemisphere and persisted throughout the 2 second encoding period. Low theta oscillatory activity also increases in the time window that precedes vocalization of a recalled word. Our data locate a human hippocampal theta oscillation between 2.5 and 5 Hz, and couple this oscillation to a specific SME.

MODULATION OF STRESS HORMONE LEVELS AT THE TIME OF MEMORY REACTIVATION: AN OPPORTUNITY TO CHANGE PREVIOUSLY ACQUIRED MEMORIES Marie-France Marin[1,2,3], Sonia J. Lupien[1,2,3]; [1]Center for Studies on Human Stress, [2]Fernand-Seguin Research Center, Louis-H. Lafontaine Hospital, [3]Université de Montréal — Glucocorticoids (GCs) are a major class of stress hormones known to modulate different memory processes. In general, high levels of GCs enhance memory consolidation whereas both low and high levels impair retrieval. Other studies show that the process of retrieval serves as a reactivation mechanism whereby the memory that is reactivated during the retrieval process is once again sensitive to modifications by environmental manipulations. Therefore, Study 1 investigated the immediate and long-term effects of a stressor on a reactivated memory. Thirty-two healthy participants (16 men) encoded a movie containing neutral and emotional slides. Two days later, they recalled the movie. Half were then exposed to the Trier Social Stress Test, a validated psychosocial stressor, whereas the others read magazines (controls). Memory was re-assessed after stress and five days later. The stressed group recalled significantly more emotional material after stress compared to controls. Moreover, this enhanced emotional memory trace was maintained five days later. Study 2 investigated whether pharmacologically lowering GC levels at the time of reactivation would impact the memory trace in a temporary or a long-lasting manner. Twenty-two healthy men encoded the movie. Three days later, they were assigned to a metyrapone (an inhibitor of GC synthesis) or a placebo condition. Memory was assessed after drug administration and four days later. At both time points, the metyrapone group recalled less emotional material compared to controls. These experiments suggest that variations in GC levels at the time of reactivation can modulate the strength of an emotional memory trace.

CHANGING THE COURSE OF MEMORY CONSOLIDATION THROUGH REACTIVATION DURING SLEEP (GSP WINNER) John Rudoy[1], Joel Voss[1,2], Carmen Westerberg[1], Ken Paller[1]; [1]Northwestern University, [2]University of Illinois at Urbana-Champaign — Initially fragile memories can gain stability via consolidation, but the manner in which sleep contributes to this process is unresolved. Reinstating a learning context during slow-wave sleep enhances retrieval of spatial information learned in that context (Rasch et al., 2007), but it remains unclear whether exposure during sleep to cues associated with newly learned information can selectively enhance the storage of individual memories. In our study, subjects learned to associate each of 50 unique object images with a location on a computer screen prior to a nap. During learning, each object was paired with a characteristic sound cue delivered over a speaker (e.g., cat/meow, kettle/whistle). During non-REM sleep in a subsequent nap, the sound cues for 25 of the objects were presented. After waking, individuals viewed all 50 objects and attempted to position each one in its original location. Accuracy was greater for objects cued during the nap than for those not cued. Additionally, EEG responses to sound cues were sorted into two conditions via a median split on the difference between pre- and post-nap accuracy. Average EEG amplitudes measured over the interval from 600-1000 ms after sound onset were greater for cues associated with less forgetting. Thus, the degree of recall improvement or decline was apparently influenced by sound-induced memory processing during sleep, as indexed by brain potentials. These results show that memory processing during sleep can be highly specific, and that auditory reminders during sleep can be used to target the reactivation and strengthening of individual memories.

ROLE OF EMOTION IN SLEEP-DEPENDENT MODULATION OF FORGETTING Rebecca Spencer[1,2], Sam Bromfield[1], Bengi Baran[1]; [1]Department of Psychology, University of Massachusetts, Amherst, [2]Neuroscience & Behavior Program, University of Massachusetts, Amherst — Sleep enhances memory consolidation. However, a long-standing proposal (Crick & Mitchinson, Nature, 1983), suggests that sleep also increases forgetting of conflicting information. Similarly, a more recent hypothesis, the Synaptic Homeostasis Hypothesis (e.g., Gilestro, Tononi, & Cirelli, Science, 2009), implies that weaker memories from the day are forgotten over sleep through global synaptic downscaling. We examined off-line changes in forgetting using the retrieval induced forgetting paradigm. Participants studied 240 word pairs formed from 40 cues, each of which was affiliated with 6 targets. Following the study phase, participants practiced retrieval of a subset of pairs, consisting of 20 cues and 3 of their affiliated targets. Following a break either with or without sleep, recall of all 240 pairs was tested. Consistent with previous reports, learning of the practiced pairs was greater following a break with sleep relative to an equivalent interval spent awake. Counter to previous hypotheses, competitive forgetting was greater over the interval spent awake relative to the interval containing sleep. Moreover, forgetting was modulated by REM sleep while memory consolidation of practiced pairs was associated with slow wave sleep. In a second study, we found that sleep-dependent consolidation of practiced pairs was similar for emotionally positive, negative, and neutral stimuli, however forgetting was uniquely modulated by the emotional valence. Together, these results suggest that sleep may play a dual-role in memory processing, reducing forgetting of weak memories during REM while consolidating stronger memories during slow wave sleep.

MULTIVARIATE SPATIO-TEMPORAL PARTIAL LEAST SQUARES ANALYSIS OF AGE-RELATED CHANGES IN BRAIN ACTIVITY DURING CONTEXT MEMORY ENCODING AND RETRIEVAL David Maillet[1], Maria Natasha Rajah[1]; [1]McGill University — Compared to healthy young adults, healthy older adults exhibit intact item memory, but impaired memory for spatial and temporal context/source. Neuroimaging studies suggest that age-related functional changes in pre-frontal cortex (PFC) and medial temporal lobes may underlie this impairment. In the present study, we examined brain activity during the encoding and retrieval of item, spatial and temporal contextual memory tasks using face stimuli, in both the young (n=25) and the elderly (n=26). Our goal was to identify the similarities and differences in brain activation during recognition and context tasks between young and elderly, using non-rotated multivariate spatio-temporal partial least squares analysis (PLS; Rajah & McIntosh, 2008). Behavioural results showed that older adults performed as well as young on item recognition, but performed worse than young on both context tasks. The PLS analysis identified a significant latent variable (LV) representing a task main effect of context versus recognition tasks at retrieval, but not at encoding, in both age groups. Specifically, both groups activated left dorsolateral PFC (Brodmann area [BA] 9), left BA 47 and left parahippocampal gyrus to a greater degree during context versus item retrieval. We found a significant LV representing group by task interactions within retrieval, but not encoding tasks. Specifically, left hippocampus was preferentially used by the young during context retrieval, while the elderly used it preferentially during recognition. Finally, we observed group differences in left BA 44 during encoding (all tasks) versus retrieval (all tasks). Young activated this region preferentially at encoding, and the elderly at retrieval.

Slide Session 5

Monday, April 19, 3:00 - 5:00 pm
Outremont Ballroom

WORKING MEMORY AND EXECUTIVE FUNCTIONS

Chair: Silvia Bunge, University of California, Berkeley

Speakers: Evelien Heyselaar, Anne Sophie Champod, Evan Gordon, Ilke Öztekin, Petroc Sumner, Frederick Verbruggen, Ignacio Obeso, Miriam Beauchamp

ABSTRACTS

THE CAPACITY LIMIT OF VISUAL WORKING MEMORY IN THE MACAQUE MONKEY (GSP WINNER) Evelien Heyselaar[1], Kevin Johnston[1], Martin Paré[1]; [1]Queen's University Canada — Working memory is a limited capacity system that allows the temporary retention of information to guide future behavior. The human visual working memory capacity has been estimated using the sequential comparison task. This limit is approximately 3 items, with values as low as 1.5 in some individuals. However, similar limits have not yet been systemically investigated in other animals, which is necessary toward development of an animal model for investigation of the neural basis of this facet of cognitive function. We estimated the visual working memory capacity of the macaque monkey using the same procedure as human studies. In this task, the animal was first presented with a memory array consisting of a varying number (set size) of highly discriminable color stimuli. The offset of the memory array was followed by a retention interval, during which the animal was required to maintain fixation. Following this, a test array was presented in which the color of one of the stimuli had changed. The animal was required to identify which stimulus had changed by making a single saccadic eye movement to its location. Animals' ability to detect a color change declined with increases in the set size and duration over which they were retained in working memory. From the relationship between performance and set size, we estimated that visual working memory in the macaque monkey has a capacity limit that exceeds two memoranda. This limit is comparable to that of humans, suggesting a shared neural substrate for this aspect of executive function.

DISSOCIATION WITHIN THE FRONTO-PARIETAL NETWORK IN VERBAL WORKING MEMORY: A PARAMETRIC FMRI STUDY Anne Sophie Champod[1], Michael Petrides[1]; [1]Montréal Neurological Institute, McGill University — Concomitant increase in activity within the mid-dorsolateral prefrontal cortex (MDLFC) and the posterior parietal cortex (PPC) is observed in most functional neuroimaging studies of working memory. Despite broad consensus on the importance of these two brain regions in working memory, the unique contribution of the PPC remains a matter of heated debate. The main objective of the present parametric event-related functional magnetic resonance imaging (fMRI) study was to examine the hypothesis that the cortex in the intraparietal sulcal (IPS) region in the PPC is involved in the manipulation (i.e. rearrangement) of verbal information in working memory and to dissociate the involvement of this brain region from the known involvement of the MDLFC in the monitoring of information in working memory. The results demonstrated a linear increase in activity within the MDLFC during the manipulation and monitoring of a linearly increasing number of words in working memory. In sharp contrast, there was a linear increase in activity within the PPC during the manipulation, but not the monitoring of a linearly increasing number of words. This study provides the first parametric dissociation of activation in these two cortical regions, indicating a crucial role of the PPC in the manipulation of information in working memory, with the MDLFC playing a major role in monitoring this information.

FUNCTIONAL CONNECTIVITY BETWEEN NETWORKS UNDERLYING WORKING MEMORY IS MODULATED BY DOPAMINE-REGULATING GENES COMT AND DAT Evan Gordon[1], Melanie Stollstorff[2], Priyanka Salona[2], Chandan Vaidya[2,3]; [1]Georgetown University Medical Center, [2]Georgetown University, [3]Children's National Medical Center — Functional magnetic resonance imaging (fMRI) reveals that some regions are activated (task-positive network - TPN) whereas others are deactivated (default mode network - DMN) during working memory (WM) performance. Studies have reported that these networks are negatively correlated; however, the nature of DMN-TPN connectivity varies across individuals. We examined whether DMN-TPN connectivity differed by genotype for the catechol-O-methyltransferase (COMT) and dopamine transporter (DAT) genes, which induce individual variation in synaptic levels of dopamine. FMRI was performed on 40 subjects during rest and during performance of a WM task. For each subject, we identified peak voxels of deactivation during WM within the posterior cingulate cortex (PCC), a DMN region, and used those as seeds for functional connectivity analysis after regressing out signal from ventricles. We observed a COMTxDAT interaction in PCC connectivity with right dorsolateral prefrontal cortex (a TPN region) during WM. Post-hoc analyses indicated that only 9/10 Met/Met subjects demonstrated negative connectivity, suggesting that differences in dopamine levels modulated the direction of the DMN-TPN relationship. We subsequently examined whether the individual differences in the DMN-TPN relationship observed during WM were also present at rest. The COMTxDAT interaction was not observed during rest, and furthermore, DMN-TPN connectivity during WM only correlated with connectivity during rest after accounting for effects of genotype on WM connectivity (residual r=.459, p<.005). This result suggests that "intrinsic" DMN-TPN connectivity observed during rest is altered due to effects of dopamine release during WM, which is affected in turn by COMT and DAT genotype.

CHANGES IN DISTRIBUTED PATTERNS OF NEURAL ACTIVATION ASSOCIATED WITH PROACTIVE INTERFERENCE RESOLUTION IN WORKING MEMORY Ilke Öztekin[1], David Badre[1]; [1]Brown University — An obstacle to successful retrieval is the presence of interference during the retrieval attempt. Proactive interference (PI), which arises from a prior learning event, is a major cause of forgetting. In this study, we sought to identify distributed patterns of neural activity that mark the retrieval of irrelevant information. This irrelevant information causes PI and leads to forgetting in working memory. Participants were scanned using functional magnetic resonance imaging (fMRI) while performing a short-term item recognition task. Trials consisted of a 5-item study list and then a recognition probe following a distractor period. To induce PI, three consecutive study lists were constructed from the same semantic category (e.g., animals), and then the category was switched (e.g., fruits) on the subsequent trial. Recognition performance decreased across successive lists of the same category, consistent with the buildup of PI. We employed a multi-voxel pattern classifier approach to track distributed patterns of brain activity that mark the retrieval of each category. Classifier success indexed the strength of the representation of each category in the brain, independent of behavioral success. Classifier success for the common category increased across the lists, consistent with the category information becoming increasingly elicited during retrieval. Critically, this increase was correlated with behavioral measures of forgetting, suggesting that the representation of non-diagnostic category information leads to a decline in memory performance. Conversely, classifier success was negatively correlated with neural activation in the left ventrolateral prefrontal cortex, consistent with this region's hypothesized role in successfully resolving competition during memory retrieval.

MORE GABA, LESS DISTRACTION: A NEUROCHEMICAL CORRELATE OF VARIABILITY IN HUMAN EYE MOVEMENT CONTROL Petroc Sumner[1], Richard Edden[2], Aline Bompas[1], Krish Singh[1]; [1]Cardiff University, [2]Johns Hopkins University — Every researcher of human behaviour knows that people perform differently, and this remains true even in the most basic situations involving the fundamentals of simple actions. Yet, although stimulating growing interest, the reasons for such differences are generally unknown. Here we show that differences in basic performance can correlate tightly with subtle neurochemical differences in relevant brain regions. We investigate the ability to inhibit an irrelevant distractor when making eye movements, and find that it is well predicted by the concentration of GABA – the main inhibitory neurotransmitter – measured by magnetic resonance spectroscopy in a region including human frontal eye field (FEF), but not in a control region. Moreover, by employing a model that distinguishes three types of motor inhibition, we can specifically associate GABA variation in the FEF region with just one of them – top-down reactive inhibition.

DISSOCIABLE CONTRIBUTIONS OF HUMAN PREFRONTAL CORTEX IN DYNAMICALLY UPDATING BEHAVIOR Frederick Verbruggen[1], Adam Aron[2], Michael Stevens[1], Christopher Chambers[3]; [1]Ghent University, [2]UCSD, [3]Cardiff University — The human cognitive control system supports flexible and goal-directed behavior by updating actions in response to changes in the environment. Cognitive psychologists have shown that dynamic updating of behavior depends on fast-acting control mechanisms that stop or change responses when they become irrelevant or inappropriate. It is currently intensely debated which regions in human prefrontal cortex support stopping and updating of behavior, and competing accounts need to be reconciled. We investigated the functional specificity of lateral prefrontal cortex in updating behavior by combining transcranial magnetic stimulation (TMS) with a novel behavioral paradigm, in which subjects had to stop or update responses on a minority of the trials. The results show that one region of lateral prefrontal cortex, the right inferior frontal junction is crucial for updating the attentional focus when an infrequent signal occurs, whereas a different region, the right inferior frontal gyrus is crucial for updating action plans in response to this signal. These findings shed new light on the role of lateral prefrontal cortex in stopping and updating behavior. In particular, the idea that right inferior frontal gyrus implements control by updating action plans reconciles recent controversial and conflicting findings about its functional role.

THETA BURST STIMULATION OVER THE PRE-SMA IMPROVED RESPONSE INHIBITION ON A CONDITIONAL STOP SIGNAL REACTION TIME TASK Ignacio Obeso[1], Leonora Wilkinson[1], Teo James[1], Talleli Penelope[1], John Rothwell[1], Marjan Jahanshahi[1]; [1]UCL Institute of Neurology, London,UK — Introduction: Volitional control over our actions often necessitates inhibition of ongoing responses. This has been investigated with the stop signal reaction time task (SSRTT). Imaging showed activation of right inferior cortex (IFC), pre-supplementary motor area (pre-SMA) and subthalamic nucleus (STN) during the SSRTT (Aron et al, 2007; Li et al, 2008). There is no consensus about their specific roles, some suggesting that the IFC and STN are involved in inhibition, while pre-SMA mediates conflict monitoring/resolution (Aron et al, 2007). Others attribute an inhibitory role to both the IFC and pre-SMA (Li et, 2008). We used the conditional SSRTT (cSSRTT) and measured inhibition and conflict induced slowing to determine if continuous theta burst stimulation (cTBS) over the IFC and pre-SMA would produce similar or dissociable effects on these measures. Methods: In a within-subjects design, fourteen volunteers performed the cSSRTT on three days (weekly intervals) after 'offline' continuous cTBS over the right IFC, pre-SMA or sham M1, with order randomized. We measured the stop signal reaction time (SSRT) and conflict induced slowing (CIS). Results: Relative to sham TBS, cTBS over pre-SMA resulted in significantly shorter SSRTs. This effect was specific to the SSRT and not observed for CIS or any other RT measures or errors. cTBS over the right IFC had no effect on any RT or error measures. Discussion: The unexpected significant shortening of SSRT with cTBS over the pre-SMA suggests that the pre-SMA made a critical contribution to volitional inhibition on the cSSRTT but did not influence conflict monitoring/resolution.

ADOLESCENT EXECUTIVE FUNCTION AND BRAIN STRUCTURE FOLLOWING CHILDHOOD TRAUMATIC BRAIN INJURY Miriam Beauchamp[1,2], Cathy Catroppa[2,3,4], Celia Godfrey[2], Sue Morse[3], Jeffery Rosenfeld[5,6], Vicki Anderson[2,3,4]; [1]Department of Psychology, University of Montréal, Canada, [2]Murdoch Children's Research Institute, Melbourne, [3]Royal Children's Hospital, Melbourne, [4]School of Behavioural Sciences, University of Melbourne, [5]Department of Surgery, Monash University, [6]Department of Neurosurgery, The Alfred Hospital, Melbourne — The impact of brain injury on skills that allow individuals to engage in purposeful, goal-directed and appropriate behaviour, commonly conceptualized as executive functions, has been a focal point of research into the cognitive outcomes of paediatric traumatic brain injury (TBI). However, few studies have addressed the long-term evolution of executive deficits in patients injured during childhood. Forty children with TBI were followed longitudinally and assessed ten years post-injury (25 male, mean age at injury = 2.0, SD = 2.7, mean age at follow-up = 14.7, SD = 0.7) and compared to nineteen healthy developing children (12 male, mean age at follow-up = 14.2, SD = 2.3) on a battery of tests measuring a range of executive functions including attentional control, inhibition, cognitive flexibility, planning, goal setting, problems solving and abstract reasoning. Results revealed that patients with mild and moderate injuries performed at age-expected levels on all tests; however severely injured patients demonstrated significant deficits particularly on complex executive functions such as planning [($F(2, 54) = 3.3$, $p =.02$)], problem solving [$F(3, 55) = 3.4$, $p = .02$], and abstract reasoning [$F(48, 3) = 5.1$, $p = .004$]. These findings highlight the lasting effects of childhood brain injury on complex executive skills and suggest that severely injured children may require ongoing intervention and support for cognitive deficits into adolescence and early adulthood.

Slide Session 6

Tuesday, April 20, 10:00 am - 12:00 pm
Outremont Ballroom

ATTENTION

Chair: Marty Woldorff, Duke University

Speakers: Sabine Heim, Stephen M. Emrich, Elana Zion Golumbic, Alexandra Woolgar, Antoni Valero-Cabre, Ana Chica, Vicki Chanon, Thomas Espeseth

ABSTRACTS

COMPETITION FOR COGNITIVE RESOURCES DURING RAPID SERIAL PROCESSING: CHANGES ACROSS CHILDHOOD Sabine Heim[1], Nadine Wirth[2], Andreas Keil[3]; [1]German Institute for International Educational Research (DIPF), [2]Central Institute of Mental Health, Mannheim, [3]University of Florida — Changes in the strategic control of attentional resource allocation play an important role for the development of complex cognitive skills and academic achievement. We examined such changes in a cross-sectional design, using the attentional-blink (AB) paradigm. The AB is an impairment of T2 report, which occurs when a first (T1) and second target (T2) embedded in a rapid stimulus sequence appear within 500 ms of each other. Two groups of children (6 to 7 year-olds and 10 to 11 year-olds; ns = 21 and 24, respectively) worked on two AB tasks (symbols in experiment 1; letters or words in experiment 2), identifying green targets in an 8.7 Hz stream. The temporal distance between T1 and T2 varied between no intervening distractor (lag 1) up to 7 intervening distractors (lag 8). Both experiments showed that older children performed more accurately overall. In the symbol task, younger children linearly increased T2 performance with increasing lag, whereas older children displayed a quadratic pattern as typically seen in adults, with a slight performance gain for the lag-1 condition. In the verbal task, younger individuals again exhibited cost effects for lag 1, whereas the older showed sparing. Impairment of T2 report at lag 1 in the younger children was not related to complementing T1 effects: they displayed greater T1 performance problems at lag 1 than older participants. Taken together, this pattern of results suggests that strategic control of temporal attention resources is a skill that emerges during primary school age.

VISUAL WORKING MEMORY MEDIATES VISUAL SEARCH EFFICIENCY (GSP WINNER) Stephen M. Emrich[1], Naseem Al-Aidroos[1], Jay Pratt[1], Susanne Ferber[1,2]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest — Visual search requires the maintenance of previously searched distractors to bias selection towards novel items. It is unclear, however, which memory system supports the indexing of these old items. Interestingly, tasks that depend on visual working memory (VWM), a capacity-limited short-term visual store, elicit an event-related potential (ERP) contralateral to the attended memory items known as the contralateral delay activity (CDA). Accordingly, in the present study we tested whether VWM supports the inhibition of old items by testing for the presence of the CDA during visual search. Our results demonstrate that a lateralized search task elicited activity contralateral to the attended search array that was indistinguishable in mean and peak amplitude from the CDA observed during a four-item change-detection task. The change in amplitude of this contralateral search activity (CSA) over time was strongly correlated with VWM capacity, suggesting that this activity reflects VWM processing. Furthermore, behavioral measures of search efficiency were strongly correlated with changes in CSA amplitude, as well as with an independent measure of VWM capacity. That is, the more items that could be stored in memory, the faster the search target was found. These findings indicate that VWM likely supports the inhibition of previously searched distractors, and consequently, that visual search efficiency is closely linked to individual VWM capacity.

NEURONAL OSCILLATIONS AS A TOOL FOR ATTENTIONAL SELECTION IN THE COCKTAIL PARTY EFFECT: INSIGHTS FROM INTRACRANIAL EEG IN HUMANS Elana Zion Golumbic[1,2], Julien Besle[1], Ashesh Mehta[3], Catherine Schevon[1], Ronald Emerson[1], David Poeppel[4], Charles Schroeder[1,2]; [1]Columbia University, [2]Nathan Klein Institute for Psychiatric Research, New York, [3]Long Island Jewish Hostpital, New York, [4]New York University — Our ability to attend to a particular conversation amidst competing input stream, epitomized by the “cocktail party” effect, is remarkable. Yet, the neural mechanisms involved in segregating, selecting and attending to one stream of conversation are not well understood. Here we tested the idea that such selection is brought about by adjusting the phase of ongoing neuronal oscillations in auditory cortex to entrain to the temporal envelope of the attended speech stream. We recorded intracranial EEG in patients undergoing electrode implantation for clinical purposes, while participants listened to segments of natural speech. We simulated a “cocktail party” by playing two conversations concurrently (male and female speakers) and instructed participants on each trial to attend to one speaker and ignore the other. In a control block the same speech segments were presented alone. In each condition, we analyzed the consistency of phases across trials (phase-locking, PL) between 1-50Hz in electrodes over auditory cortex. In the cocktail-party conditions, despite the identical physical stimulus, the PL pattern was modulated as a function of attention. Specifically, the PL pattern elicited when attending to a particular segment was highly correlated with the PL pattern elicited when listening to that segment alone (in the control condition). In addition, similarities were observed between the PL pattern and the spectro-temporal structure of the speech envelope. The results strongly support the idea that the brain entrains its internal neuronal oscillations to the rhythmic structure of an input, and that this mechanism is utilized as a tool for selective attention.

ADAPTIVE REPRESENTATION OF TASK-RELEVANT INFORMATION IN FRONTOPARIETAL CORTEX Alexandra Woolgar[1], John Duncan[1]; [1]Medical Research Council - Cognition and Brain Sciences Unit — In human functional magnetic resonance imaging (fMRI), a characteristic pattern of frontal and parietal activity is produced by many different cognitive demands. These ‘multiple-demand’ regions are thought to be critical for flexible goal-directed behavior. The adaptive coding hypothesis posits that they achieve cognitive control by the adaptive representation of task-relevant information. We used multi-voxel pattern analysis (MVPA) of human fMRI data to demonstrate adaptive coding of stimulus, rule and response information in a visual stimulus-response task. When the perceptual difficulty of the task was increased, frontoparietal regions showed significantly increased coding of perceptual information. At the same time, low-level visual areas showed significantly weakened coding of perceptual information, in line with the physical change in the visual stimulus. These changes occurred dynamically, across short alternating blocks of high and low perceptual difficulty. Coding of other task-features was concurrently redistributed across the multiple-demand system, such that together the frontoparietal regions continued to represent all the information needed for the task. The results are consistent with the conception of the frontoparietal multiple-demand regions as a flexible neural system that exerts cognitive control in a wide range of tasks by adaptively representing the task-features that are relevant for successful goal-directed behavior.

AREAS UNDERLYING THE DEPLOYMENT OF SPATIAL ATTENTION IN THE HUMAN BRAIN: A ¨BLIND¨ TMS MAPPING OF PARIETAL AND FRONTAL REGIONS Antoni Valero-Cabre[1,2], Claudia Peschke[3], Kurtev Stoyan[3], Roxana Voitcu[3], Yu Jin[3], Richard Rushmore[2], Claus Hilgetag[3,4]; [1]CNRS UMR 5105-INSERM S975, Paris, France, [2]Boston University School of Medicine, [3]Jacobs University Bremen, Germany, [4]Boston University — Prior TMS studies have suggested that a myriad of distinct regions in the human brain contribute to the processing of spatial attention. We used a basic visual detection/localization task and applied TMS to systematically map, in an anatomically "blind" manner, the right and left parietal and frontal subregions likely to generate significant visuo-spatial biases. Two groups of 8 adult subjects executed a task based on the detection of black dots on light-gray background. Targets were displayed unilaterally or bilaterally for 40 ms, at 25o with a back-projection system. In two independent experiments, a 9 (3x3) stimulation sites grid was anchored lateral to P3 and P4 EEG coordinates for the parietal mapping and 2 cm rostral to M1 for the frontal mapping. Three pulses of real or sham 10 Hz TMS were delivered on each grid location 50 ms post target onset to interfere with the ongoing stimulus processing. In the parietal mapping, real TMS on the right and left IPS region, 2 cm ventral to IPS, and slightly above TPJ induced mirror-symmetric ipsilateral spatial biases. In the frontal mapping, significant reductions in detection rates for contralateral stimuli and increased detection performance for ipsilateral targets were observed for the region anatomically associated with right FEF, while TMS of left frontal sites yielded spatially non-selective results. We conclude that the effects of TMS on a simple spatial localization task for which a well-balanced deployment of attention is required, are exquisitely spatially selective, and mostly noted in specific right parietal and frontal regions.

THE CAUSAL ROLES OF THE DORSAL AND VENTRAL FRONTO-PARIETAL NETWORKS IN ORIENTING SPATIAL ATTENTION Ana Chica[1], Antoni Valero[1,2], Paolo Bartolomeo[1,3,4]; [1]INSERM-UPMC UMR-S 975, Paris, France, [2]CNRS-UMR 5105, Paris, France, [3]AP-HP, Groupe Hospitalier Pitié-Salpêtrière, Fédération de Neurologie, Paris, France, [4]Catholic University, Milan, Italy — Attention can be spatially oriented in a top-down or bottom-up manner. Corbetta et al. (2008) have proposed that a dorsal network (including the Intra-Parietal Sulcus –IPS, and the Frontal Eye Field –FEF) is mostly involved in attentional orienting (both bottom-up and top-down), while a ventral network (including the Temporo-Parietal Junction –TPJ, and the Inferior Frontal Gyrus –IFG) is not related to the orienting of attention but is key in re-orienting attention to unexpected events. We tested the causal roles of the right IPS and TPJ during bottom-up orienting of spatial attention using Transcranial Magnetic Stimulation (TMS). Participants were presented with a spatially non-informative peripheral cue that preceded the to-be-discriminated target by either 200 or 800 ms. Two TMS pulses were delivered 50 ms post-cue presentation to interfere within a 100 ms time window. Attentional effects for cues presented ipsilaterally to the stimulation side were as expected, showing facilitation at the short interval, and inhibition at the longer one. Importantly, for contralateral cues, a dissociation was observed when TMS was applied to IPS and TPJ. TMS pulses on IPS abolished the orienting of attention while TMS on TPJ produced a facilitatory effect even at the long SOA, where inhibition was expected. Our results indicate that both the dorsal and the ventral network play a causal role in orienting attention, although their effects are clearly dissociable. The abnormal facilitation observed after TPJ stimulation mimics the characteristic attentional deficits observed in patients with right hemisphere damage suffering from neglect (Bartolomeo & Chokron, 2002).

NEURAL CORRELATES OF ATTENTIONAL BIAS TOWARD CIGARETTE CUES IN ACTIVE SMOKERS Vicki Chanon[1], Charlotte Boettiger[1]; [1]University of North Carolina at Chapel Hill — Data suggest that craving triggered by drug cue exposure results in part from abnormal allocation of attention to drug cues in substance-dependent individuals (SDIs). The importance of investigating the neural bases of such bias is highlighted by evidence that its strength predicts risk of relapse. Little is known about the neural correlates of addiction-related attentional bias. To address this issue, we tested active smokers (AS, n=12) and non-smokers (NS, n=11) using fMRI with a spatial cuing paradigm designed to measure attentional bias toward smoking-related images. Behavioral measures revealed a bias toward smoking cues in AS. We also observed selective enhancement of activity in the Inferior Frontal Gyrus in response to smoking cues, specific to the AS group. We speculate that this reflects a need for increased inhibitory control in AS when the salient, yet irrelevant smoking cues were present. In addition, we observed enhanced activity, specific to AS, in response to targets congruent with a smoking cue (relative to incongruent) in a constellation of areas implicated in attention and cognitive control, including the inferior frontal junction, orbitofrontal cortex (OFC), anterior cingulate cortex (ACC), temporoparietal junction, and precuneus, as well as the right caudal hippocampus. Abnormalities in the OFC and ACC are implicated in executive dysfunction among SDIs. Moreover, the ACC projects throughout the frontoparietal attention system. Our data suggest that the ACC biases this system to attend to smoking stimuli. Identifying these biomarkers of addiction-related attentional bias provides new putative targets for development of therapeutic interventions for addictive disorders.

NICOTINIC RECEPTOR GENE CHRNA4 INTERACTS WITH PROCESSING LOAD IN ATTENTION Thomas Espeseth[1], Markus Sneve[1], Helge Rootwelt[2], Bruno Laeng[1]; [1]University of Oslo, Norway, [2]University Hospital of Oslo, Norway — Pharmacological studies have suggested that cholinergic neurotransmission mediates increases in attentional effort in response to high processing load in attention demanding tasks (Sarter et al. 2006). In the present study we tested whether individual variation in CHRNA4, a gene coding for a subcomponents in the alpha4beta2 nicotinic receptors in the human brain, interacted with processing load in a multiple object tracking task (MOT) and a visual search task (VS). We hypothesized that genotype would predict performance in both tasks under high load, but not low load. One hundred forty six healthy persons (age range=39 – 77, mean=55.6, sd=9.0) performed the MOT task in which twelve identical circular objects moved about the display in a random manner. Two to six objects were targets and the remaining objects were distractors. The same observers also performed a visual search for a target letter (i.e. X or Z) presented together with five non-targets while ignoring centrally presented distractors (i.e. X, Z, or L). Targets differed from non-targets by a unique feature in the low load condition, whereas they shared features in the high load condition. CHRNA4 genotype interacted with processing load in both tasks. Homozygotes for the T allele (N=48) had better tracking capacity in the MOT task and identified targets faster in the VS task, and these differences occurred only in high load conditions. The results support the hypothesis that the cholinergic system modulates attentional effort, and that common genetic variation can be used to study the molecular biology of cognition.

Slide Session 7

Tuesday, April 20, 1:00 - 3:00 pm
Outremont Ballroom

PERCEPTION & ACTION

Chair: Kevin Wilson, Gettysburg College

Speakers: Corianne Rogalsky, Sara Fabbri, Aline Bompas, Sander Daselaar, Frank Scharnowski, Nathan Parks, Simon Davis, Andrew C. Connolly

A B S T R A C T S

THE RELATIONSHIP BETWEEN SPEECH PERCEPTION AND THE HUMAN "MIRROR SYSTEM": EVIDENCE FROM LESION CASE-STUDIES Corianne Rogalsky[1], Tracy Love[2], David Driscoll[3], Steven Anderson[3], Gregory Hickok[4]; [1]University of Southern California, [2]San Diego State University / University of California, San Diego, [3]University of Iowa, [4]University of California, Irvine — The discovery of mirror neurons in macaque has led to a resurrection of motor theories of speech perception. In particular, it has been proposed that the "human mirror system", which prominently includes Broca's area, is the neurophysiological substrate of speech perception. Although numerous studies have demonstrated a tight link between sensory and motor speech processes, few have directly assessed the critical prediction of mirror neuron theories of speech perception, namely that damage to the human mirror system should cause severe deficits in speech perception. The present study tested this prediction by measuring speech perception abilities of subjects with lesions involving motor regions in the posterior frontal lobe and/or the left inferior parietal lobule (i.e. the proposed human "mirror system"). A subset of subjects had lesions that also included temporal regions. Subjects completed a psycholinguistic battery to assess their phonological, lexical, and sentence-level speech comprehension and production abilities. Signal detection analyses indicate that performance was near ceiling in the word comprehension and discrimination tasks for patients with damage to the "human mirror system". Perceptual deficits were evident only when the lesion encroached on auditory regions in the temporal lobe. Perceptual deficits in patients with temporal lobe involvement were particularly evident on non-word stimuli compared to word stimuli even when stimuli were equated for phonological neighborhood density and phonotactic frequency. These results suggest that damage to the human "mirror system" does not disrupt speech perception and argue instead that auditory systems are the primary substrate for speech perception. Supported by NIH-DC03681.

ABSTRACT CODING OF MOVEMENT DIRECTION IN HUMAN SUPERIOR PARIETAL CORTEX (GSP WINNER) Sara Fabbri[1], Alfonso Caramazza[1,2], Angelika Lingnau[1]; [1]University of Trento, [2]Harvard University — Neurons in monkey motor cortex are broadly tuned for movement direction: activity of a neuron is highest for the preferred movement direction and decreases gradually with increasing angular difference between the preferred and non-preferred direction. Here we aimed to identify areas with similar properties in the human brain. In particular, we asked if there exists an abstract representation of movement direction that remains invariant despite changes in low-level parameters, like the type of motor act (to grasp vs to press). Using functional magnetic resonance imaging (fMRI) adaptation, we identified several areas within the human visuo-motor system whose blood-oxygen level dependent (BOLD) activity was modulated by the angular difference between adapted and test hand movement directions. In particular, right superior parietal lobe (SPL) showed pronounced directional tuning that was not affected by the type of motor act (to press vs to grasp). Most other regions in the dorsal pathway showed directional tuning that was significantly modulated by the type of motor act. In contrast, the BOLD response in left and right cerebellum was modulated by movement direction and type of motor act, but not by their interaction. These results suggest that the control of directional movements in the human brain relies on a network of areas selective for movement direction at different levels of abstractness. Such an abstract representation of movement direction might play an important role for the dynamic control of movement direction irrespective of changes in low-level muscle parameters as well as for transformations from visual to motor coordinates.

MEG SIGNATURES OF SACCADIC CHOICE AND SPEED DIFFER: A CRITICAL TEST FOR DECISION MODELS Aline Bompas[1], Iain Gilchrist[2], Suresh Muthukumaraswamy[1], Krish Singh[1], Petroc Sumner[1]; [1]Cardiff University, CUBRIC - School of Psychology, [2]Bristol University — A fundamental prediction of all accumulator models of decision is that choice and latency are related, because latency to one visual target and choice between two possible targets are determined by the same factor – how soon activity for a particular response reaches threshold in an action planning area. We used magnetoencephalography (MEG) to design a critical test for this attractive though unchallenged assumption. Participants made saccades to onset targets (left or right), and on one third of the trials had to choose freely between two simultaneous targets (left and right). We split these bilateral trials according to the choice made (left versus right) and compared the MEG activity during the 200 ms before the stimulus onset (baseline). Similarly in single target trials, we compared the baseline MEG activity preceding fast and slow saccades. While choice was predicted by frontal differences in the alpha frequency band (5-15Hz), speed was predicted by non-lateralised occipital differences in the alpha and beta bands (5-30Hz), the two signatures showing no similarities, even at the sub-significant level. Our results suggest that different baseline settings specifically modulate choice and speed, in contrast with the central assumption of accumulator models.

MODALITY-SPECIFIC AND MODALITY-INDEPENDENT COMPONENTS OF THE HUMAN IMAGERY SYSTEM Sander Daselaar[1], Yuval Porat[1], Willem Huijbers[1], Cyriel Pennartz[1]; [1]University of Amsterdam — Imagery research typically deals with the commonalities and differences between imagery and perception. As such, it is usually confined to one specific modality. Yet, it is likely that some of the underlying processes are shared between different sensory modalities while others are modality-specific. In this fMRI study, we used a balanced design that allowed for a direct comparison between imagery and perception in visual and auditory modalities, and also for a link between subjective imagery experience and brain activation. Results indicated a selective role for the "default mode network" as a modality-independent "core" imagery network. This finding supports the idea of a general role of the DMN in rich mental imagery involving multiple sensory components. In addition, results identified areas in the visual and auditory association cortices that contributed to mental imagery in a modality-specific fashion. The finding of shared imagery-related and perception-related activity in VA and AA within one single task suggests that, even though these regions are processing different features of imagined objects, they share a common processing level situated at an advanced stage in the hierarchy of the human sensory system. Interestingly during mental imagery, primary visual and auditory cortices showed modality-specific suppression of activity. Suppression of primary sensory regions may help the processing of internally-generated images or sounds by shielding the associative sensory regions from external perceptual input processed by primary regions. This is the first fMRI study to characterize both modality-specific and modality-independent components of the human imagery system.

MANIPULATING VISUAL PERCEPTION WITH REAL-TIME FMRI-BASED NEUROFEEDBACK TRAINING Frank Scharnowski[1], Chloe Hutton[1], Oliver Josephs[1], Nikolaus Weiskopf[1], Geraint Rees[1]; [1]University College London (UCL) — Spontaneous fluctuations of ongoing brain activity have a profound impact on perception. For example, human observers are more likely to perceive a visual stimulus if baseline activation in visual cortex at the time of presentation is higher. Here, we used real-time fMRI-based neurofeedback to train participants to voluntarily regulate the ongoing brain activation of circumscribed areas in their early visual cortex. We then tested how such self-regulated activation influenced subsequent processing of a visual stimulus presented near threshold. We found that the level of activation within early visual cortex directly influenced objective detection thresholds, i.e. when the participants increased activation they became better at detecting a visual stimulus. A control group who received feedback from a non-visual brain region did not learn to control visual cortex activation and did not show changes in visual sensitivity. Hence, with real-time fMRI-based neurofeedback it is possible to learn voluntary control over visual cortex activation and thereby to improve visual sensitivity. This new approach allows us to now study perception as a variable which is dependent on self-regulated brain activation, and therefore to investigate causal links between brain activation and percfeption.

NEURAL CORRELATES OF SHORT-TERM VISUAL PLASTICITY AND CORTICAL DISINHIBITION IN HUMANS Nathan Parks[1], Paul Corballis[2]; [1]Beckman Institute, University of Illinois at Urbana-Champaign, [2]Georgia Institute of Technology — Restricting visual input from a circumscribed region of space induces representational plasticity within retinotopically organized visual areas such that deafferented cortex begins to represent new spatial locations. The extent of such plasticity is most compelling over the long-term but functional changes begin within seconds of retinal deafferentation. The neural mechanism proposed to underlie short-term visual plasticity is one of disinhibition whereby a reduction of local inhibition within deafferented areas renders them more sensitive to inputs from surrounding cortex. We investigated the neural mechanisms of short-term visual plasticity and disinhibition in humans using a stimulus-induced analog of retinal deafferentation known as an artificial scotoma – a uniform area stabilized upon a dynamically changing background. Artificial scotomas provide a useful model of short-term visual plasticity as they temporarily mimic the perceptual and neural changes that accompany a true retinal scotoma (pseudo-deafferentation). In a series of studies we measured contrast response functions and visual evoked potentials (VEPs) from within the boundaries of an artificial scotoma (scotoma condition). In comparison to a closely matched control (sham condition), psychophysical functions exhibited contrast-dependent effects indicative of increased spatial integration but decreased stimulus selectivity. VEPs elicited from within the boundaries of an artificial scotoma exhibited enhanced amplitude of early sensory components, indicating that reduced stimulus selectivity is associated with increased neural gain in pseudo-deafferented visual cortical areas. Results follow the predictions of disinhibition and suggest that short-term visual cortical deafferentation is associated with increased spatial integration as well as a nonselective increase in neural response gain.

THE COGNITIVE, FUNCTIONAL, AND STRUCTURAL ARCHITECTURE OF CROSS-HEMISPHERIC COMMUNICATION IN YOUNGER AND OLDER ADULTS Simon Davis[1], James Kragel[1], David Madden[1], Roberto Cabeza[1]; [1]Duke University — In order to investigate the neural mechanisms of cross-hemispheric communication and how they change as a function of aging, we (1) assessed cross-hemispheric transfer using bilateral-unilateral matching task, (2) linked behavioral results in this task to fMRI connectivity (FC) between homologous regions across hemispheres, and (3) linked FC to DTI measures of white matter integrity in the corresponding cross-hemispheric tracts. (1) Replicating previous research, we observed that (a) matching was faster for bilateral than unilateral trials (bilateral processing advantage), (b) that this effect increased with matching difficulty, and (c) occurred a lower difficulty levels for older than younger adults. (2) FC was greater at higher levels of task difficulty between homologous regions in frontal, temporal, and parietal lobes; older adults showed a similar pattern but in a greater number of homologous regions. (3) Finally, FC in several pairs of homologous regions was significantly correlated with white matter integrity (fractional anisotropy) in the corresponding tracts; white matter integrity was also correlated with the bilateral processing advantage. These effects were stronger in older than younger adults. Taken together, the findings support a hypothetical causal chain whereby changes in white matter integrity (#3) modulate changes in FC (#2) which in turn modulate cross-hemispheric transfer and behavioral performance (#1). The results are also consistent with the notion that greater communication between the hemispheres engenders more efficient processing in response to increased task demands, and that older adults show greater reliance on a bilaterally distributed network, possibly reflecting functional compensation.

MULTI-VOXEL SIMILARITY STRUCTURE ANALYSIS REVEALS TAXONOMY OF ANIMAL SPECIES IN HUMAN VENTRAL TEMPORAL CORTEX Andrew C. Connolly[1], James V. Haxby[1]; [1]Dartmouth College — Our goal is to develop a detailed account of the structure of the representation of living things in the brain and how this structure emerges in the object vision pathway, investigating three regions: medial occipital (MO), inferior occipital (IO), and ventral temporal cortex (VT). Our approach is based on the analysis of similarity structure for multi-voxel patterns defined by responses to a variety of animate categories using functional magnetic resonance imaging (fMRI). During fMRI scanning, subjects (N=12) viewed photographs of six animal species—two species each of insects, birds, and primates. Pair-wise distances between condition patterns were used to construct 15-dimensional neural similarity spaces, where each dimension corresponds to the distance between a species pair. The similarity structures revealed how categorical representations take shape along the visual processing pathway. Patterns in early visual cortex (MO) are less differentiated in general than in IO and VT, and without clear category structure. In IO, there is strong differentiation between the vertebrates and the insects, while in VT each intermediate-level category becomes clearly defined. Similarity structures are highly stable and replicable both within and between subjects—especially in VT with an average between-subject correlation of r=.91, which is higher than that for regions earlier in the visual processing stream: IO, r=.75; MO, r=.65. Similarity-based multi-voxel pattern analysis reveals a categorical structure in ventral temporal cortex that mirrors our knowledge about animal species, providing a window into the structure of neural representations that form the basis of our categorical knowledge of the living world.

Emotion & Social: Person Perception

A1

THE DEVELOPMENT OF CATEGORY-CONTINGENT FACE PROTOTYPES: AN EXAMINATION OF OPPOSING ATTRACTIVENESS AFTEREFFECTS IN FIVE-YEAR-OLD CHILDREN Lindsey Short[1], Catherine Mondloch[1]; [1]Brock University — Simple aftereffects provide evidence that adults process individual faces in reference to a prototype that is continuously updated by experience. Following repeated exposure to faces distorted in one direction (e.g., compressed features), adults rate similarly distorted faces as more normal and more attractive. Opposing aftereffects provide evidence that adults have multiple face prototypes (e.g., male/female; Caucasian/Chinese) that are processed by dissociable neural populations (e.g., Jaquet, Rhodes, & Hayward, 2008). Following adaptation to two face categories that are distorted in opposite directions (e.g., compressed Chinese faces and expanded Caucasian faces), adults' judgments of attractiveness and normality shift in opposite directions. Here we used a child-friendly method to examine whether 5-year-olds show simple and opposing aftereffects. In Experiment 1, 5-year-olds read a storybook in which all faces were distorted in one direction (e.g., compressed). Like adults and 8-year-olds, 5-year-olds' attractiveness preferences shifted in the direction of adaptation, $p < .05$. In Experiment 2, 5-year-olds read a storybook in which Caucasian and Chinese faces were distorted in opposite directions. Unlike adults and 8-year-olds, 5-year-olds' attractiveness preferences did not shift in opposite directions, $p > .10$. The lack of opposing aftereffects for race of face may indicate that 5-year-olds reference all faces to a single prototype. Alternatively, 5-year-olds may have multiple prototypes for only a subset of face categories. To examine whether children process boy versus girl faces with dissociable neural populations, we are currently investigating opposing aftereffects for sex of face in 5-year-olds—a category that is highly salient to young children.

A2

MIRRORING OF PAIN FACES, EMOTIONAL CONTAGION, AND EMPATHY Adrienne Moore[1], Paul Ruvolo[1], Megan O'Rorke[1], Tingfan Wu[1], Andrea Chiba[1], Gwen Littlewort[1], Javier Movellan[1], Marian Stewart-Bartlett[1]; [1]University of California, San Diego — Social cognition relies heavily on processing the emotional facial expressions of people in our environments. Mirroring, or mirror neuron system based activity, has been suggested as a mechanism for inferring from external facial displays of emotion how others feel internally. The goal of this study was to investigate the role of mirroring in response to faces expressing pain, the role of emotional contagion in response to faces expressing pain, and the relationship between mirroring, emotional contagion and empathy. Mirroring in the form of facial mimicry was indexed using the Computer Expression Recognition Toolbox, CERT, to quantify the facial muscle movement of subjects as they observed video stimuli of confederates performing real and fake cold pressor pain tasks. Specifically, mimcry was indexed as correlations between muscle activity of the subjects' faces and of the pain faces they observed. Emotional contagion was assessed by measuring autonomic nervous system mediated physiological changes, specifically, heart rate, heart rate variability, and respiratory rate. Trait empathy was measured using the Interpersonal Reactivity Index questionnaire, and empathic accuracy was measured using the task of distinguishing real from fake expressions of pain. The results of this study show that facial mimicry behavior does occur when observing pain faces and also predicts aspects of trait empathy and empathic accuracy. This study motivates a follow-up study using EEG to assess whether the mu rhythm, said to reflect mirror neuron system activity, is involved in these effects.

A3

DISTINCT EARLY CORTICAL ROUTES FOR THE STRUCTURAL AND EXPRESSIVE ASPECTS OF HUMAN BODY PERCEPTION, AN MEG STUDY Hanneke Meeren[1], Nouchine Hadjikhani[2,3,4], Seppo Ahlfors[2,3], Matti Hämäläinen[2,3], Beatrice de Gelder[1,2,3]; [1]Tilburg University, Netherlands, [2]Athinoula A. Martinos Center for Biomedical Imaging, MGH/MIT/Harvard Medical School, [3]Harvard-MIT Health Sciences and Technology, [4]Brain Mind Institute, EPFL, Lausanne, Switzerland — The perceptual processing of fearful expressions in the face may already be initiated around 100-120-ms after stimulus presentation, demonstrating that emotional information of a face can be encoded before the identity of the face is fully recognized. Recent findings indicate that the same may be true for emotions expressed by the human body. The neural basis of this proposed early stage of emotion analysis is however poorly understood. To address this question we used magnetoencephalography (MEG) and anatomically-constrained distributed source modeling to monitor brain activity with millisecond-resolution while subjects viewed still images of whole human bodies in a neutral and a fearful expression. In addition, an MEG experiment was performed to study the dynamic functional mapping of body-selectivity. Significant emotion effects were found from 80 ms after stimulus onset in areas outside the body-selective areas. Fearful body expression did not modulate the prominent responses in the well-established body-selective area of the EBA. In contrast, the responses in fusiform gyrus, which did not show any body-selectivity before 500 ms poststimulus, were strongly boosted by the expression of fear around 230 ms. Later in time, the two aspects of body processing converged in the orbitofrontal area, showing strong body-selectivity and a sustained emotion effect between 300-700 ms after picture onset. Our results suggest that structural body encoding and body-expression are processed by separate cortical routes early in the processing stream, and converge in the orbitofrontal region after 300 ms poststimulus.

A4

INDIVIDUAL DIFFERENCES IN PERCEIVING THREAT FROM DYNAMIC FACES AND BODIES Mariska Kret[1,2], Johan Denollet[2], Beatrice de Gelder[1,3]; [1]Cognitive and Affective Neurosciences Laboratory, Tilburg University, the Netherlands, [2]CoRPS - Center of Research on Psychology in Somatic diseases, Tilburg University, the Netherlands, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA — We express and communicate our emotional states and action tendencies with our bodies of which facial expressions are an integral part. A growing literature demonstrates that different personality traits are associated with specific coping styles which translate to unique activity patterns in the brain. Two functional magnetic resonance imaging (fMRI) experiments investigated how areas involved in processing social signals are activated more by threatening signals (fear and anger) from facial and bodily expressions and how this relates to a distressed personality, characterized by high emotional distress (negative affectivity) which is consciously suppressed (social inhibition). A negative correlation was observed between negative affectivity and activation in brain areas commonly involved in emotional processes: amygdala (AMG), fusiform gyrus (FG), insula, superior temporal sulcus (STS) and inferior frontal gyrus (IFG) (Brodmann area 45). Furthermore, increased activation was observed in the secondary somatosensory cortex (SII), anterior intraparietal sulcus, left temporo-parietal junction (TPJ) and left OFC with more social inhibition following threat. The results suggest that people with high scores on social inhibition rely more on the conceptual knowledge they have about emotion, imagining themselves in the perceived state, whereas people without these personality traits activate the well-known emotion areas. Our findings demonstrate the striking effects of personality in a non-clinical population, and show how this can distinguish the neural coding of anger and fear signals.

A5

MAJOR DEPRESSIVE DISORDER BIASES THE RECOGNITION OF EMOTIONAL PROSODY Julie Peron[1,2,3], Sarah El Tamer[1], Didier Grandjean[2], David Travers[1,4], Dominique Drapier[1,5], Marc Vérin[1,2], Bruno Millet[1,5]; [1]Université Rennes, Hôpital Pontchaillou, CHU de Rennes, Rennes, France, [2]Clinique Neurologique, Hôpital Pontchaillou, CHU de Rennes, Rennes, France, [3]Neuropsychology of Emotion and Affective Dynamics lab, Swiss Center for Affective Sciences, Geneva, Switzerland, University of Geneva, [4]Service des Urgences, Hôpital Pontchaillou, CHU de Rennes, Rennes, France, [5]S.H.U. Psychiatrie Adulte, CH Guillaume Régnier — Major depressive disorder patients presented biased interpretation of facial expressions toward negative emotion but also away from positive one suggesting that responsiveness to positive emotional stimuli would be blunted in depression. Nevertheless, the question as to whether these emotional biases induced by depression are modality-specific has yet to be answered. The objective of this study was therefore to examine the effects of depression on the recognition of emotional prosody using a paradigm which are ill-suited to capture subtle effects of biases in information processing. An original emotional prosody paradigm using different kinds of pseudowords produced by 12 actors with 5 emotional prosody judged on continuous scales was administered to 21 major depressive disorder patients, and 21 controls matched for sociodemographical variables. As compared to control, depressed patients displayed significant recognition of emotional prosody impairment for fear, happiness, and sadness; furthermore, they also rated the fear scale significantly more intensely when they listened to anger stimuli. Similarly, the depressed patients were biased on the rating of the surprise scale, rating this scale significantly more intensely when they listened to sad or fearful utterances. Furthermore, these contrasts revealed that when they listened to happiness, depressed patients rated negative scales more intensely as compared to control. These results suggest the impaired recognition of emotional expressions is not specific to the visual modality and that major depressive disorder biases the recognition of emotional prosody toward negative emotional stimuli but also that the blunting of positive one would not be specific to the visual modality.

A6

THE INFLUENCE OF CONTEXT ON EMOTIONAL FACE PROCESSING Charlotte B. A. Sinke[1,2], Jan Van den Stock[1], Rainer Goebel[2], Beatrice de Gelder[1,3]; [1]Cognitive and Affective Neurosciences Laboratory, University of Tilburg, the Netherlands, [2]University of Maastricht, the Netherlands, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, MA — Humans rapidly recognize and understand facial expressions of others, as shown by numerous behavioral and neuroimaging studies. An important factor that may influence this recognition process is the context in which the face is perceived. Affective scenes have already shown to influence an ERP component (the N170) of facial expressions, indicating that the face is already at an early stage encoded differently in an affective context. Using functional magnetic resonance imaging, we tried to investigate the influence of an emotional scene on the neuronal processing of fearful and neutral faces. Fourteen participants were being scanned while they were shown photographs (248 trials) of either a fearful, neutral or no face in a fearful, neutral or scrambled scene. To stay focused, they had to respond to an oddball. The experiment consisted of four runs of 31 blocks. Eight stimuli were presented per block for 800 ms with an interval of 350 ms. Also, a functional localizer for the perception of faces, bodies, houses and tools was used. Our main results replicate previous findings that fusiform and occipital face areas are modulated by facial emotion. In addition, activity in right fusiform gyrus increases for fearful faces when they are in a fearful scene. Occipital face area shows less activation for a neutral face when it is presented in a fearful versus a neutral scene. Parahippocampal place area and retrosplenial cortex show less activation for a scene when it is fearful.

A7

SOCIAL APPRAISAL: THE APPRAISAL OF OTHERS INFLUENCES OUR PERCEPTION OF FACIAL EXPRESSIONS OF EMOTION Christian Mumenthaler[1,2], David Sander[1,2]; [1]Laboratory for the Study of Emotion Elicitation and Expression, University of Geneva, Geneva, Switzerland, [2]Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland — The concept of appraisal plays a central role in various theories of emotion. Although the number, definition, and order of appearance of appraisals vary between theories, so-called "appraisal theories" of emotion, all agree on the notion that emotions are elicited by subjective evaluations (appraisals) of events and situations. Even if the causes and social functions of emotions are generally recognized by the literature, appraisal processes have in general been studied independently of the social context. However, the concept of « social appraisal » proposes that the appraisal of an emotional event made by an individual is influenced by the appraisal that other individuals make of the very same event. We tested this proposal by asking participants to identify a dynamic facial expression of emotion that was presented at the centre of the screen while another face, which appeared simultaneously in the periphery of the screen, was expressing an emotion. We also manipulated the gaze direction of the face in the periphery to differentiate the effect of the "social appraisal" from the effect of general background information. Our results suggest that appraisal made by others affect our perception of facial expressions of emotion. We found that "social appraisal" facilitates the categorization of facial expressions of anger, joy and fear when the context was expressing the same emotion. It also allowed a better categorisation of facial expression of fear when the context was expressing anger and vice versa. Importantly, the effect of "social appraisal" differed from the effect of general background information.

A8

NEURAL BASES OF EMOTION PERCEPTION REFLECT RELATIVE RELIANCE ON NONVERBAL AND CONTEXTUAL SOCIAL CUES Jamil Zaki[1], Kelly Hennigan[2], Jochen Weber[1], Kevin Ochsner[1]; [1]Columbia University, [2]Stanford University — Every day, individuals must make decisions about how others are feeling, based on complex, sometimes contradictory nonverbal and contextual social cues. However, extant research on the neural bases of social cognition has often used simplified stimuli that do not approximate real-world social information. This work has identified two dissociable neural systems involved in processing different types of social information: the mirror neuron system, which supports deciphering of action intentions based mainly on nonverbal behavior, and the mentalizing system, which supports explicit appraisals of internal states based mainly on contextual information. Nonetheless, the way these systems interact during processing of realistic social cues remains unclear. In this study, we collected whole-brain fMRI data while participants watched silent videos of social targets describing emotional experiences (nonverbal social cues), read sentences describing targets' emotional experiences (contextual social cues), or saw both videos and sentences concurrently (multimodal social cues); when multimodal cues were presented, videos and sentences were sometimes congruent in valence, and sometimes incongruent. In all cases, participants rated the emotion they believed targets were experiencing. Nonverbal social cues selectively engaged the mirror neuron system, whereas contextual cues selectively engaged the mentalizing system. When multimodal cues were presented, and suggested incongruent affective valence, engagement of the mirror neuron system predicted perceivers' reliance on nonverbal information in making their subsequent rating, and engagement of the mentalizing system predicted their reliance on contextual information. These results represent a step towards understanding the ways that multiple neural systems contribute to decisions about realistic, complex social information.

A9

HOW MUCH CAN I TRUST YOU? AN FMRI INVESTIGATION OF THE NEURAL MECHANISMS UNDERLYING THE IMPACT OF SOCIAL INTERACTIONS ON DECISION MAKING Sophie Flor-Henry[1], Keen Sung[1], Ekaterina Denkova[1], Sanda Dolcos[1], Florin Dolcos[1]; [1]University of Alberta — The "friend or foe" judgements, which are important for survival, are often based on first impressions, which in turn may affect our social and financial decisions. In the present study, functional magnetic resonance imaging (fMRI) data were recorded while participants viewed and rated videos of guest-host interactions in a business setting. The host displayed behaviors that either encouraged (Approach condition) or discouraged (Avoid condition) further social interactions. Analyses of behavioural data (N=29) showed that the Avoid trials were associated with lower host trustworthiness and competence scores, as well as with subjects' decreased willingness to engage in business interactions with the host. Preliminary analyses of the fMRI data (N=8) identified enhanced activity in the superior temporal sulcus [STS] (a part of the brain's "social cognition network") to both the Approach and Avoid trials, compared to a no-social interaction condition, while also showing greater sensitivity to the Avoid condition. Furthermore, STS activity for the Avoid condition was also positively correlated with participants' trustworthiness ratings. In addition, there was also a negative correlation between the trustworthiness ratings and activity in the amygdala [AMY] (a brain region associated with emotion processing) in Avoid trials. These findings suggest that STS and AMY activity index processing of behavioral cues that allow discrimination of foes from friends. These findings have relevance for understanding the neural substrates of the impact of affective non-verbal communication on social interactions, and for understanding clinical conditions in which the impact of emotional content of social situations is altered (e.g., autism, social phobia).

A10

SOCIAL IDENTITY ORGANIZES FACE PERCEPTION: THE FUSIFORM FACE AREA RESPONDS PREFERENTIALLY TO MEMBERS OF AN EXPERIMENTALLY CREATED INGROUP Jay Van Bavel[1], Dominic Packer[2], William Cunningham[3]; [1]New York University, [2]Lehigh University, [3]The Ohio State University — There has been extensive research on a region of the fusiform gyrus critical for recognizing faces – termed the fusiform face area (FFA). However, it remains an open question whether the FFA is sensitive to shifting social dynamics. One possibility is that facial processing in the FFA may be relatively invariant and other neural systems may be recruited to imbue faces with social meaning. Another possibility is that social context may provide a direct, top-down influence on representations in the FFA. The current fMRI study explored the sensitivity of the FFA to an experimentally created social identity. We assigned participants to one of two arbitrary groups, then had them visually identify ingroup and outgroup faces and complete a FFA localizer during neuroimaging. The FFA was selectively engaged during presentation of experimentally created ingroup (> outgroup) faces, even when the intergroup distinction was random, there were no visual cues to distinguish group membership, and exposure to the faces was equivalent, brief (~15 minutes) and recent. The results suggest that a currently salient group membership – however arbitrary – may recruit the FFA to visually identify fellow group members in the absence of long-term experience with that category. Although these results are consistent with models suggesting that the FFA plays a general role in subordinate processing of stimuli within a category (Palmeri & Gauthier, 2004), our data suggest that long-term experience is not necessary to engage these processes. Instead, top-down influences like social identity can influence FFA activity in a dynamic fashion.

A11

REAL DUMMY MAY SHED LIGHT ON FUNCTIONAL SIGNIFICANCE OF TOM-RELATED BRAIN ACTIVITIES J. Bruno Debruille[1], Mathieu Brodeur[1], Ursula Hess[2]; [1]McGill University, [2]Université du Québec à Montréal — As they resemble real persons, dummies' faces are likely to trigger the automatic attribution of mental states during early automatic processes. Accordingly, our first hypothesis was that the early posterior negativities, that is, the EPN of the event-related potentials (ERPs) they evoke could be similar to those elicited by a real face. However, because dummies are objects and thus things to which no mental state should be attributed, this mental state processing could stop later. Accordingly, greater anterior N2-400s to the dummy's face could be predicted following previous works that suggested that such activities could index down regulations of the amygdala by the ventromedial prefrontal cortex (vmPFC). Nevertheless, an opposite prediction could be made following the greater N2-400 found in a theory of mind (ToM) task than in control task, namely, that the N2-400 could be absent for stimuli for which no mental state should be attributed. To test which of these last two hypotheses is correct; ERPs elicited by the face of a dummy sitting in front of the participant were compared to those elicited by the face of a real person in the same position. Control ERPs elicited by the photos of these two stimuli were also recorded. The four stimuli were found to elicit similar EPNs, suggesting that they all triggered similar automatic attributions of mental states. In accordance with the first hypothesis, the face of the real dummy was found to elicit larger anterior N2-N400s than the three other stimuli.

A12

EFFECTS OF CHRONIC PAIN AND PAIN BEHAVIORS ON THE SENSITIVITY TO THE PAIN OF OTHERS Etienne Vachon-Presseau[1], Marc-Olivier Martel[2], Mathieu Roy[3], Micheal Sullivan[2], Jackson Philip[4], Rainville Pierre[1]; [1]Université de Montréal, [2]McGill University, [3]Columbia University, [4]Université Laval — Empathy for pain is a complex process in which the observer's knowledge and experience of pain is combined to a cognitive evaluation of another person's feelings. The purpose of the present study was to examine if chronic pain patients varying in their tendency to display pain behaviors are more sensitive to others' pain. Patients with idiopathic back pain (n=21) classified as «high» or «low» pain expressers based on a standardized task, and matched for pain duration, age and sex, were compared to 21 age- and sex-matched pain-free participants. Subjects rated the intensity of the pain represented in 2s pictures of hand (n=16), foot (n=16) and face (n=16) displaying neutral (50%) or painful (50%) situations/expressions. Ratings of the pain stimuli showed no effect of category (hand, foot, face; p=0.13) or interaction group*category (p=0.78), but revealed a significant difference between the 3 groups (main effect, p=0.038; high > control, p=0.012; high > low, p=0.067). In addition, a Pearson correlation revealed a significant linear relation between the patients' pain-behavior scores and ratings of the pain observed (r = 0.52; p = 0.016). These results suggest that patients with a stronger tendency to display pain behaviors are more sensitive to stimuli signaling pain in others. However, this effect is not specific to pain communicative signals (face) and may reflect a generalized hypervigilance to environmental cues signaling potential injury or pain-related situations.

A13

THE NEURAL ARCHITECTURE OF SOCIAL ATTRIBUTION Aron Barbey[1], Jordan Grafman[1]; [1]Cognitive Neuroscience Section, National Institute of Neurological Disorders and Stroke, National Institutes of Health — Cognitive neuroscience has made considerable progress in understanding the involvement of the prefrontal cortex (PFC) in social cognition. Accumulating evidence demonstrates that representations within the lateral PFC (lPFC) enable people to orchestrate their thoughts and actions in concert with their intentions to support goal-directed social behavior. Despite the pivotal role of this region in guiding social interactions, remarkably little is known about the functional organization and forms of social knowledge mediated by the lPFC. We develop an integrative cognitive neuroscience framework for understanding the social functions of the lPFC, drawing upon recent theoretical developments in evolutionary psychology and emerging evidence from the social and decision neuroscience literatures demonstrating the importance of this region for orchestrating behavior on the basis of evolutionarily adaptive neural mechanisms for social attribution. We propose that the lPFC mediates central elements of social attribution, including (1) inferring causal relationships, (2) productively applying this knowledge to predict and explain social interactions, and (3) utilizing both forms of knowledge to navigate the social world. These forms of social inference are functionally organized along the dorso-ventral axis of the lateral PFC, whereby the process of inferring the cause(s) of social behavior recruits the dorsolateral PFC, and applying this knowledge to predict and explain social interactions engages the ventrolateral PFC. Adaptive behavior guided by both categories of inference recruits the anterolateral PFC, which represents the highest level of a rostro-caudal hierarchy characterized by multiple forms of social inference. We review a broad range of neuroscience evidence to support this proposal.

A14

THE MIRROR NEURON SYSTEM IN AUTISM SPECTRUM DISORDERS: THE ROLE OF SOCIO-EMOTIONAL CONTEXT Peter Enticott[1], Hayley Rhook[1], Nicole Rinehart[1], Bruce Tonge[1], John Bradshaw[1], Paul Fitzgerald[1]; [1]Monash University, Australia — Impairments in social relating are the hallmark of autism spectrum disorders (ASD). An increasingly prominent explanatory model suggests that reduced activity within the mirror neuron system (MNS) might precipitate these social impairments. When considering the clinical profile of autism, our understanding of the role of the MNS in ASD might be enhanced by examining mirror neuron activity that occurs whilst viewing socio-emotional behaviour. Individuals with ASD and matched healthy controls underwent a transcranial magnetic stimulation (TMS) experiment designed to measure mirror neuron activation. TMS was administered to the primary motor cortex while participants viewed stimuli depicting static or active human hands. Motor-evoked potentials (reflecting cortical excitability) were recorded from the contralateral first dorsal interosseus. Visual stimuli designed to elicit a mirror neuron response involved intransitive movements, transitive movements, and movements with an implied socio-emotional context. Participants with ASD displayed reduced cortical excitability when viewing transitive movements, but seemingly appropriate cortical excitability when viewing socio-emotional movements. Thus, although some mirror neuron impairments were evident in ASD, a socio-emotional component appeared to promote a substantial mirror neuron response in each group. The link between mirror neuron activation and aspects of autism (both social and non-social) appears to be extremely complex, and there may be broader neurocognitive and neurophysiological processes involved. These findings have implications for our understanding of the neuropathophysiology of ASD, particularly in terms of motor resonance and the subsequent impact on social cognition and empathy.

A15

BRINGING REAL SOCIAL LIFE IN THE LABORATORY : EEG HYPERSCANNING OF JOINT ATTENTION Fanny Lachat[1,2,3], Laurence Conty[4,5], Laurent Hugeville[1,2,3], Guillaume Dumas[1,2,3], Jacques Martinerie[1,2,3], Nathalie George[1,2,3]; [1]Université Pierre et Marie Curie-Paris 6, Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, UMR-S975, Paris, France, [2]Cnrs, UMR 7225, CRICM, Paris, France, [3]Inserm, U 975, CRICM, Paris, France, [4]Inserm, U 960, Laboratoire de Neurosciences Cognitives, Paris, France, [5]Ecole Normale Supérieure, Paris, France — Gaze is a key element of interpersonal interaction. In everyday social situations, we dynamically follow the gaze of others as well as attract their look onto objects of interest. This phenomenon is called joint or shared attention. It has typically been studied in laboratory setting using on-screen face display with Posner like attention orienting paradigm. However, real life situation and physical presence may be an essential component of joint attention. Furthermore, joint attention may be reflected in the synchronization of endogenous oscillators in the subjects' brain. Our aim was to create a real life situation in the laboratory room. Specifically, we aimed at 1) evaluating gaze-induced attention orienting in real life setting; 2) recording electrical brain activity of participants' couples during different events of joint, anti joint attention, and mutual gaze. Subjects placed face-to-face had to look at each other and to gaze at either same or different diodes placed between them in successive trials. The EEG signals of subjects' couples were recorded simultaneously (EEG hyperscanning). Our results first show that real gaze induces robust attention orienting: participants were 17 ms faster ($p<.02$) at detecting diode colour change under joint relative to anti-joint attention condition. We will also present preliminary EEG results, comprising time-frequency analysis of intra- as well as inter-individual synchronization. We expect that joint attention induces synchronization between parts of the brain both intra- and inter-individually. Our results show the feasibility of bringing everyday human interaction into the lab. It offers new exciting prospects for social neuroscience.

A16

YOU DON'T LOOK HAPPY, JUST SILLY! ERPS TO PROTOTYPICAL AND NON-PROTOTYPICAL FACES Silke Paulmann[1,2], Marc D. Pell[2]; [1]University of Essex, Colchester, UK, [2]McGill University, Montréal, Canada — Many previous studies have examined event-related brain potential (ERP) correlates of processes acting on emotional and non-emotional (i.e., neutral) faces. These studies, which assume that differential brain responses reflect direct differences in neural processes subserving face processing, have identified how and when information about prototypical (or "basic") emotion displays is processed in the face. However, in "real-life" situations we often encounter socially-relevant facial expressions that do not correspond to specific emotion prototypes, for example when someone grimaces or "pulls a face". The question arises whether these non-prototypical facial expressions follow similar processing stages as prototypical emotion displays and/or neutral facial expressions, which was addressed by the present study. We compared ERPs elicited by faces conveying prototypical affective expressions, non-prototypical affective expressions, and neutral faces to further specify the time course of (emotional) face processing. Results showed that prototypical and non-prototypical facial expressions could each be differentiated from neutral expressions in three different ERP component amplitudes (P200, early negativity, and N400), which are believed to index distinct processing stages in facial expression decoding. Based on the distribution of effects, our results suggest that early processing is mediated by shared neural generators for prototypical and non-prototypical facial expressions; however, later processing stages appear to engage distinct sub-systems for the three facial expression types investigated according to their emotionality and meaning status.

A17

IMPAIRED SOCIAL INFERENCE IN PEOPLE WITH UNILATERAL TEMPORAL LOBE DAMAGE Melanie Cohn[1,2], Darlene Floden[3], MaryPat McAndrews[1,2]; [1]Krembil Neuroscience Centre, [2]University of Toronto, [3]Cleveland Clinic — Evidence from neuroimaging and lesion studies suggests that the temporal lobes are implicated in social cognition. For instance, people with bilateral or right-sided damage to the amygdala have difficulties identifying facial emotions. However, few studies have investigated other aspects of social perception in such individuals. Our goal was to examine social inference abilities in people who underwent unilateral right or left temporal lobe excisions (TLE; including the amygdala, hippocampus, and varying extents of anterolateral neocortex) for the treatment of intractable epilepsy. We used The Awareness of Social Inference Test (TASIT), which consists of video clips depicting sincere, sarcastic and deceitful exchanges followed by yes/no inference questions pertaining to the actions, verbal statements, feelings and beliefs of the characters. Both left and right TLE groups performed within the normal range of ability on questions pertaining to the sincere clips, suggesting intact comprehension and short-term retention of the exchanges. However, both groups performed poorly on items pertaining to the sarcastic and deceitful exchanges. These results confirm the involvement of the temporal lobes in social inference abilities. Clinically, our results also raise the possibility that a neurologically-based deficit in social perception may contribute to the psychosocial difficulties experienced by people with unilateral temporal lobe damage.

A18

IS IT OUR PROBLEM OR YOURS? COOPERATION INCREASES ELECTROPHYSIOLOGICAL RESPONSES TO OBSERVED ERRORS Leonie Koban[1], Gilles Pourtois[2], Roland Vocat[1], Patrik Vuilleumier[1]; [1]University of Geneva, [2]University of Gent — Monitoring one's own actions and errors is a fundamental ability to guide and improve behavior, with specific neural substrates in the anterior cingulate cortex. Similarly, we can also monitor others' actions and learn by observing their errors. Multiple mirror neuron systems were proposed to subserve this formation of shared representations for self-generated and observed actions, and recent research suggests that monitoring mechanisms also react to observed errors. However, it remains unknown how these responses are modified by a divergence between the observer's and the actor's intentions and factors of interpersonal relationship. To investigate whether differences in social context can influence brain response to observed action errors, we manipulated competition versus cooperation between two participants taking turns in a speeded Go/No-Go task. Event-related potentials simultaneously recorded from both participants showed a typical negativity over frontocentral regions to self-generated errors, irrespective of interpersonal context; but early differential responses to other-generated errors only during cooperation. Competition produced a distinct error-related negativity at later latencies. These differential effects correlated with perceived closeness and rivalry, but not with empathy or perspective taking. We conclude that error monitoring for others' actions depends on their congruence with personal goals and the interpersonal relationship, and recruits brain systems involved in self-referential processing specifically during cooperation.

A19

JUDGING AGGRESSIVENESS BASED ON FACIAL STRUCTURE: SENSITIVITY TO FACIAL WIDTH-TO-HEIGHT RATIO IN OWN-VERSUS OTHER-RACE FACES Catherine Mondloch[1], Cheryl McCormick[1], Justin Carré[1], Genyue Fu[2], Daisy Ma[2], Kang Lee[3]; [1]Brock University, [2]Zhejiang Normal University, [3]University of Toronto — Facial width-to-height ratio in male faces is significantly correlated with laboratory measures of reactive aggression and penalty minutes received by hockey players (Carré & McCormick, 2008). Adults' judgements of aggressiveness are correlated with the width-to-height ratio of the stimulus faces and with actual aggression of the men, suggesting that this ratio may be used as an 'honest signal' advertising propensity for aggression (Carré et al., 2009). Here we compared adults' sensitivity to width-to-height ratio in own- versus other-race faces. Caucasian and Chinese adults (n = 60 per group) rated aggression for Caucasian and Chinese faces (n = 24 faces per race). For each participant we calculated the correlation between aggression ratings and width-to-height ratio for each face set. Single sample t-tests revealed above-chance performance for own- and other-race faces, $ps < .001$. A 2 (participant race) x 2 (race of face) ANOVA indicated that Caucasian participants performed better overall, $p < .001$ and revealed a Participant Race x Race of Face interaction, $p < .05$. For Caucasian participants the mean correlation was higher for Caucasian faces (M = .396) than Chinese faces (M = .320), $p < .05$; the reverse was observed for Chinese participants (Ms = .265 and .210 for Chinese and Caucasian faces, respectively), $p = .08$. These data suggest that differential sensitivity to spatial differences among own- versus other-race faces extends beyond judgements of identity (Rhodes et al., 2006) to judgments of aggression and support that the facial ratio may be an "honest signal" irrespective of race.

A20

THE NEURAL CORRELATES OF STIGMA FOR PHYSICAL DIFFERENCES Sook-Lei Liew[1,2], Tong Sheng[1,3], Lisa Aziz-Zadeh[1,2,3]; [1]The Brain and Creativity Institute, University of Southern California, [2]The Division of Occupational Science & Occupational Therapy, USC, [3]The Neuroscience Graduate Program, USC — The stigmatizing effects of a physical difference can negatively impact one's psychological experiences and social functioning. While prior research suggests that observations of socially-stigmatized individuals (e.g., transsexuals) yields increased activity in regions associated with fear and disgust, little attention has been paid to the stigma of physical differences (PD). Additionally, it is unknown how observations of individuals with PD affect activity in the mirror neuron system (MNS), an action-understanding network hypothesized to encode the goals of an action even when the body parts used differ. Using fMRI, we scanned typically-developed participants as they observed actions performed by a woman without arms (PD) and women with intact limbs (controls). When observing PD perform actions versus controls, there was increased activity only in visual regions, whereas observations of controls versus PD generated increased activity in sensorimotor, visual, and mentalizing regions. When specifically observing PD perform actions with her stump versus controls performing hand actions, participants had greater activity in regions previously associated with social stigma, emotions, perspective-taking, and visual processing. In contrast, when observing controls perform hand actions versus PD, increased activity was found in frontoparietal regions of the MNS. These results suggest that stigma for physical differences may include regions associated with social stigma along with increased visual activity. Additionally, MNS activity was present only for controls but not for PD, suggesting that there is increased motor resonance with those more physically similar to oneself and that there may be a disruption of this goal-matching system when observing differently-bodied individuals.

A21

NUCLEUS ACCUMBENS AND PREFRONTAL CORTEX ARE RECRUITED WHEN WOMEN VIEW SEXUALLY ATTRACTIVE FACES Kristina Caudle[1], Rebecca Boswell[1], Krista DeStasio[1,2], Jane Tucker[1], Katie Von Holzen[1,3], Todd Heatherton[1], William Kelley[1]; [1]Dartmouth College, [2]York College, [3]University of Wisconsin - Green Bay — Men and women show different neural responses when rating opposite-sex faces on attractiveness (Cloutier et al., 2008). Men recruit both the nucleus accumbens (NAcc), involved in automatic processing of rewarding or motivating stimuli, and the orbitofrontal cortex (OFC), perhaps reflecting more explicit evaluation. Women show only an increase in NAcc activity. However, it is unknown whether this difference is attributable purely to sex differences, or if the difference in activation patterns reflect differences in the way men and women naturally judge attractiveness. Whereas men may consider sexual appeal when judging attractiveness, women may default to a more aesthetic consideration of physical features. Here, we attempted to disambiguate earlier findings by explicitly directing participants to use each of two scales: a pure "aesthetic attractiveness" dimension, and a separate "sexual attractiveness" scale. Specifically, female participants were imaged using fMRI while rating male faces on a three-point scale. For half of the faces, subjects made physical attractiveness judgments; for the remaining half, subjects made sexual desirability judgments. Results revealed that women recruit both NAcc and prefrontal regions when making sexual judgments, suggesting that women can and do recruit similar brain regions as men, but only when explicitly instructed to consider sexual desirability. This suggests that sex differences in neural responses to attractive faces may be driven, in part, by different default definitions of "attractiveness" between men and women.

A22

DISENTANGLING PSYCHOPATHIC STATUS FROM GENERAL INCARCERATION STATUS IN EVENT-RELATED POTENTIAL RESPONSES TO EMOTIONAL FACES Meghan J. Weissflog[1], Sidney J. Segalowitz[1], Gillian E. S. Munro[1], Jane Dywan[1]; [1]Brock University, St. Catharines, ON, Canada — Emotion recognition deficits, particularly for fearful expressions, have been consistently reported in both clinical and subclinical populations high in psychopathic traits. Similarly, recent neuroimaging data suggest there may be functional differences in the way psychopaths process emotion. However, most such research compares incarcerated psychopaths to a community sample control. The current study examines the stimulus-locked P2 and N2 event-related potential responses to emotional face stimuli observed during a face flanker task in a sample of both psychopathic and nonpsychopathic offenders and normative controls. For both the P2 and N2 components, the offender group differed significantly from the control group, such that the offenders produced larger average amplitudes when compared to controls at sites P3 ($p = .001$) and P4 ($p = .001$) for the P2 component and sites FCz ($p = .004$) and Fz ($p < .001$) for the N2 component. However, within the offender group, psychopaths and nonpsychopaths were on the whole similar, with the exception that nonpsychopaths differed from normative controls more than the psychopaths in general. Thus, previous studies reporting emotional face processing differences amongst psychopaths may have confounded the factor of incarceration.

A23

UNDERSTANDING FICTIONAL MINDS: WATCHING A MOVIE RECRUITS BRAIN REGIONS INVOLVED IN MENTALIZING Dylan D. Wagner[1], Todd F. Heatherton[1]; [1]Dartmouth College — For many people, a large portion of their free time is spent watching fictional characters interacting with one another in films and television. This rich natural stimulus affords an excellent opportunity to examine the conditions under which people spontaneously recruit brain regions involved in mental state reasoning (e.g. mentalizing). Prior research on natural film viewing has largely ignored the question of whether viewing social interactions in films recruits the same brain regions as explicit mentalizing tasks (for an exception see Mar, Kelley, Heatherton & Macrae, 2006). In the present study, 39 participants watched the first 30 minutes of a popular Hollywood film. Scenes were coded for the presence of a single character, two characters engaged in a social interaction or for scenes without people (e.g. landscapes). Results revealed that brain regions involved in mental state attribution (e.g. DMPFC, TPJ, Temporal poles) were spontaneously recruited when participants watched on-screen social interactions. During scenes in which the protagonist was alone on-screen, activity was observed only in visual regions involved in face processing and animate motion (e.g. FFA & STS). Taken together, these findings argue that when viewing fictional social interactions people recruit the same neural machinery they use for explicit mental state reasoning. Moreover, it appears that activity in DMPFC and TPJ is preferentially tuned to social interactions and is less responsive to watching intentional, but non-social, behavior.

A24

THE NEURAL SUBSTRATES OF EMOTION PERCEPTION IN ADOLESCENTS WITH ASD Daniel O'Young[1], Jasmin Cloutier[1], Elizabeth Redcay[1], Tom Meagher[1], Penelope Mavros[1], Joe Moran[1], Vanessa Vogel-Farley[2], Charles Nelson[2], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Children's Hospital Boston — Abnormal brain activation when processing information from faces has been identified in Autism Spectrum Disorder (ASD). These atypical neural responses to faces are believed to be part of the social impairments of ASD individuals. Indeed, the many social cues that can be extracted from faces can convey a wealth of social communicative information, particularly through facial expression. As such, face processing has been used to probe into the neural circuitry underlying abnormal social processing in ASD individuals. More specifically, atypical amygdala activation has been hypothesized to underlie some of these deficits. Nevertheless, to date, the results of investigations into the neural responses to facial expressions in ASD have been inconsistent. To better characterize the neural responses to facial expressions in ASD individuals, we collected functional MRI data from typically developing and ASD adolescents. For this purpose we used a blocked design functional imaging paradigm during which participants viewed pictures of neutral, angry and fearful faces, as well as houses. Eye-tracking data was also collected in a separate session to ensure that participants were looking at the eye region of the face. Participants were all male and between 14 to 20 years of age. Compared to typically developing adolescents, the results suggest that ASD adolescent may have atypical amygdala responses to neutral and angry faces. These results confirm that amygdala activity might underlie abnormal person perception in ASD individuals.

A25

INTEGRATION OF FACE AND VOICE OCCURS ONLY AT THE LATER STAGES OF IDENTITY PROCESSING Aida Owlia[1], Heather Jordan[1]; [1]School of Kinesiology and Health Sciences, Centre for Vision Research, York University — Social information associated with a specific individual is considered to be hierarchically organized (Bellin et al., 2004). General information e.g. age and gender is extracted before more specific aspects e.g. identity. Identifying an individual can occur through the visual (e.g. photograph) and/or auditory (e.g. telephone) modality, and in practice both types of information are often present. Combining information across perceptual modalities would seem optimal. The neural basis for integrating identifying information across perceptual modalities is poorly understood. Perceptual adaptation effects have been reported for social information within the visual and the auditory domain. Prolonged exposure to male faces changes the observer's percept of a subsequent gender-neutral stimulus so that it appears more female (Webster et al., 2004). Similarly, listening to male voices subsequently alters judgments of gender-neutral voices (Schweinberger et al., 2008). Cross-modality adaptation has not been reported, raising the possibility that adaptation of social information may be domain-specific perceptual information. To test this hypothesis, observers were exposed to visual (pictures of faces), auditory (voices) and visual+auditory (simultaneous faces and voices) adapters before judging morphed test faces based on gender (exp. 1) or identity (exp. 2). Adaptation effects were never observed when voices (Auditory) were used as adapting stimuli. Early stages of identification processing i.e. gender were found to rely on domain-specific input. Higher-level processing (identity) utilized only integrated perceptual information. Cross-modal integration of social information only occurs at the later stages of processing. Physiological correlates of category-specific adaptation effects will be presented.

A26

TOP-DOWN MODULATION OF SOCIAL PERCEPTION BY MENTAL-STATE ATTRIBUTION Christoph Teufel[1], Paul Fletcher[1], Nicola Clayton[1], Dean Alexis[1], Greg Davis[1]; [1]University of Cambridge — Extensive neuronal networks in the human brain are specialized for perceiving and processing complex social information allowing us to make inferences about another person's mental states. Observed gaze direction is a particularly important cue in this respect. Single-unit recordings in macaques and gaze-adaptation experiments in humans have critically furthered our understanding of the gaze-processing system by revealing distinct populations of neurons responsible for coding specific directions of another person's gaze direction. However, our understanding of the influence of high-level Theory of Mind mechanisms on these processes is still rudimentary. Here we show that the attribution of a mental state to another person determines the way in which the human brain codes observed gaze direction. Specifically, we adopted a gaze-adaptation paradigm which exploits systematic distortions in perception following prolonged exposure to gaze stimuli in order to study the gaze-processing system. We convinced observers that prerecorded video sequences of an experimenter gazing left or right were a live video link to an adjacent room. An elaborate deception procedure guaranteed that observers believed that the person in the videos was either able or unable to see. The results show that the effects of adaptation were enhanced under the former condition relative to the latter, indicating that high-level mental-state attribution shapes and modulates sensory coding of observed gaze direction. These findings have important implications for our understanding of the healthy social brain and may explain how aberrant mental-state attribution in psychopathology contributes to the persistence of delusions despite contrary sensory evidence.

A27

MY TEAM IS "30 MS" FASTER THAN YOUR TEAM OR HOW INTER-GROUP RIVALRY CHANGES THE PERCEPTION OF ACTION Pascal Molenberghs[1], Veronika Halász[1], Jason Mattingley[1], Eric Vanman[1], Ross Cunnington[1]; [1]The University of Queensland — People have a tendency to see members of their own team more favorably than members of another team. For example, while watching our favorite sport team most of us tend to see our own team's players in a better light compared to the opponents. Here we use psychophysics and fMRI in an action perception task to show that participants who are arbitrarily divided into two groups (a red team and blue team) see the movements of their own team members on average 30 ms faster than the equivalent movements of opposing team members. fMRI results show that all the people who show a bias in favor of their own team perceive the actions of their team differently than actions from the other team with the inferior parietal lobule in a crucial role. Implicit group identification measures confirmed that participants identified more with their own team than with the other team. Our results show that, in a competitive situation, group membership changes objective judgment in favor of in-group members because people perceive actions of own team members differently. This study brings together research in perception of actions and inter-group bias and may explain why supporters often feel that their team has been mistreated by an objective referee during sport competitions.

A28

TRIANGLES HAVE GOALS TOO Richard Ramsey[1], Antonia Hamilton[1]; [1]University of Nottingham, UK — A striking feature of human cognition is the liberal way thoughts, feelings and intentions are attributed to human and non-human entities. Current models distinguish two brain networks involved in this process. A 'mentalising' network is responsive when one attributes mental states, such as beliefs and desires, to people and animate shapes. A 'mirror neuron system' responds to the observation of simple, goal-directed hand actions and is associated with goal understanding. However, this dichotomy does not predict what brain and cognitive processes might be involved when humans ascribe simple goals to non-human shapes that do not have bodies. Using functional magnetic resonance imaging, we report that anterior intraparietal sulcus, a brain region known to represent goals of human actions, also encodes the goals of non-human shapes, such as triangles. This result suggests that the division of the social brain into a 'mirror neuron – simulation' network and a 'mentalising – inference' network is too simplistic. Simulation mechanisms are unlikely to allow goal-inference for triangles that have no human form or motion, but our data show that part of the simulation network represents these goals. We suggest that a conceptual approach to social cognition may be more informative. Under this framework, anterior intraparietal sulcus may provide an abstract representation the goal 'take-object', whether performed by a human actor or by a non-human shape. Moreover, the division between 'mirroring' and 'mentalising' would parallel the distinction between the concept of a simple object-goal and the concept of a belief or social intention.

A29

NEURAL ACTIVITY DURING FACIAL AFFECT RECOGNITION: MEN VS. WOMEN Jessica Devitt[1], Garrett Hosack[2], Stephen Lewis[1,2]; [1]University of New Mexico Health Sciences Center, [2]New Mexico Veteran's Health Care Center, Clinical Neuroscience Research Program — Goal: Females (F) identify facial affects with greater accuracy than males (M), yet no clear neurologic explanation for these findings has been established 1,2. We sought to identify differences in neural activity between males and females during affect recognition. Methods: Subjects (F; N=5, M; N=5 underwent magnetoencephalography (MEG) during presentation of 6 different facial affects (anger, sadness, disgust, fear, happy, neutral, and a non-face control). Responses of the fusiform gyrus (FFG) cortex were collected at ~170ms for each condition. Data were analyzed to investigate the relationship between gender and response amplitude. Using the novel source-analysis VEctor-based Spatial-Temporal Analysis (VESTAL) 3, MEG data was coalesced with sMRI data to localize activity on the 3-D brain. Data were also averaged according to gender, creating both a male and female average brain and comparing FFG activity between the two. Results: Males had lower MEG amplitudes than females. The mean for males was 3.05 (95% CI 1.97 - 4.14) while the mean for females was 6.13 (95% CI 5.05 - 7.22), p = 0.0001. VESTAL results suggest more lateralization of responses in males than in females. Conclusion: We have demonstrated a difference in FFG activity between male and female subjects in strength and lateralization of responses to facial affect. References: 1. Hall, J.A. (1978) Psychol. Bull. 85(4): pp. 845–857; 2. Miura, M. (1993) Shinrigaku Kenkyu. 63(6): pp. 409–413; 3. Huang, M.X., et. al. (2006) Neuroimage. 31: pp.1025-1037.

A30

THE EFFECTS OF VALENCE AND AROUSAL ON HEMISPHERIC ASYMMETRY OF EMOTION: EVIDENCE FROM EVENT-RELATED POTENTIALS Jing Zhang[1], Renlai Zhou*[1,2,3], Tian P. S. Oei[4]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [2]Key Laboratory of Child Development and Learning Science, Southeast University, Nanjing, China, [3]Beijing Key Lab of Applied Experimental Psychology, Beijing Normal University, Beijing, China, [4]School of Psychology, University of Queensland, Brisbane, Australia — The independent influence of valence and arousal on emotional hemispheric brain asymmetry was investigated to inform the debate over three contrasting hypotheses: the right dominance hypothesis, the valence hypothesis, and the integrative hypothesis. Event-related potentials (ERPs) were recorded while participants (N = 20) viewed positive high arousal, positive low arousal, negative high arousal and negative low arousal pictures, following a baseline measure of ERPs while viewing gray squares. Self-ratings of emotional state in terms of valence and arousal were taken after each of the four emotion blocks. Valence and arousal effects on hemispheric asymmetry were analyzed for the time windows 130-170 ms, 170-280 ms, 280-450 ms, 450-600 ms. Results indicated that the arousal dimension of emotion interacted with the valence dimension in modulating the anterior hemispheric asymmetry of emotion, associated with right dominance on N2 during negative high arousal and left dominance on P3 and LPC during negative low arousal in the anterior lobe. The result also suggested that the dimension of arousal played a main role in the posterior hemisphere asymmetry, with right dominance on P2, P3 and LPC in the posterior lobes during high arousal. Our result partly supported the right hemisphere hypothesis and the integrative hypothesis in the posterior lobe, and did not provide evidence for valence hypothesis. *corresponding author rlzhou@bnu.edu.cn 1. Supported by Program for Changjiang

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A31

TRAINING EFFECTS ON NEURAL CORRELATES OF THE OWN-RACE BIAS Johanna Stahl[1], Holger Wiese[1], Stefan R. Schweinberger[1]; [1]Friedrich Schiller University of Jena — People are generally better at recognizing faces from their own ethnic group as compared to faces from another ethnicity. This so-called own-race bias has been attributed to perceptual learning and lifetime expertise with faces of one´s own ethnicity. The current study aimed at simulating expertise with other-race faces by training naïve Caucasian participants to individuate own-race (Caucasian) and other-race (Asian) faces. Following extensive multi-session training, a comparison of recognition performance for own- and other-race faces indicated a general attenuation of the own-race bias from pre-training to post-training, a finding which was largely due to decreased recognition performance for Caucasian faces. Furthermore, event-related potentials to own- and other-race faces revealed effects of training on early components. Whereas N170 was delayed and increased to Asian as compared to Caucasian faces, training induced a general N170 latency decrease. More importantly, specific and ethnicity-dependent effects of training were evident in the occipito-temporal P2 component, which initially exhibited more positive amplitudes to Caucasian faces than to Asian faces. Whereas this effect was visible over both hemispheres before training, the P2 amplitude difference between Caucasian and Asian faces disappeared over the left hemisphere following training. This result demonstrates training-induced changes in early face encoding processes. Taken together with a lowered own-race bias after training, the P2 effects may reflect changes in an expertise-dependent system that represents individual faces and is capable of adapting and responding to perceptual training.

A32

THE EFFECTS OF STATUS ON THE NEURAL SUBSTRATES OF PERSON PERCEPTION: A DISSOCIATION OF MORAL AND HIERARCHIC STATUS INFORMATION Thomas Meagher[1], Jasmin Cloutier[1,2], Nalini Ambady[2], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Tufts University — The identification and evaluation of status information is of great importance to all social animals. In humans, the construal of social status is more flexible than in other animals and varies across numerous dimensions. For example, some individuals obtain a high social status due to their financial accomplishments, others because of their perceived moral accomplishments. The current study examines the effect of different types of status information on the neural substrates of person perception. In an event-related fMRI experiment, participants were presented with the faces preceded by either low or high hierarchic status information (e.g., "earns $25 000" or "earns $350 000") or low or high moral status information (e.g., "is a tobacco company executive" or "is a cancer researcher"). Subjects were asked to form an impression of the targets using the information available about them. Based on previous findings, regions of interest analyses were performed for brain regions we expected to be more sensitive to the hierarchic status of the presented faces (i.e., IPS) as well as brain regions we expected to be more sensitive to the moral status of the presented faces (i.e., ventromedial prefrontal cortex). The results reveal a neural dissociation between the effects of these different social status cues on person perception.

A33

THE NEURAL SUBSTRATES OF PERSON PERCEPTION IN ADOLESCENTS WITH ASD: THE INFLUENCE OF LIKABILITY AND DOMINANCE Jasmin Cloutier[1,2], Daniel O'Young[1], Tom Meagher[1], Eliabeth Redcay[1], Joe Moran[1], Nalini Ambady[2], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Tufts University — Abnormal ability to extract social information from faces is linked with some of the social impairments of individuals with Autism Spectrum Disorder (ASD). A wealth of social information can efficiently be inferred from facial cues. The neural substrates underlying these social inferences from faces involve a network of brain regions supporting social cognitive abilities. Atypical recruitment of some of these brain regions is suggested to underlie the social communicative deficits of ASD individuals. For example, atypical amygdala activation has been hypothesized to be involved in some of these deficits. Few brain-imaging investigations of person perception in ASD have focused on identifying the neural responses to the different social cues that can be inferred from faces. To further characterize the neural substrates of person perception in ASD individuals, we collected functional MRI data from typically developing and ASD adolescents while they were presented with faces varying on likability and dominance. Specifically, we used an event-related fMRI design during which participants performed a one-back task on a series of faces preselected to vary on these social dimensions. Following the scanning session, all participants rated the previously presented faces on likability and dominance. These ratings were subsequently used to identify components of the so-called social brain that displayed differential activation to faces judged to vary on likability or dominance. Difference patterns of brain responses were observed in ASD and typically developing adolescents, particularly in the amygdala and superior temporal sulcus. Amongst these results, ASD individuals displayed greater amygdala activity to liked faces.

A34

ADAPTATION TO VOICE CARICATURES AND ANTI-VOICES REVEALED PROTOTYPE-BASED CODING OF VOICE IDENTITY Marianne Latinus[1], Pascal Belin[1]; [1]Centre for Cognitive Neuroimaging CCNi and Department of Psychology, Universty of Glasgow — Although a speaker never utters the same sound twice, normal listeners are efficient in extracting voice invariants and using them to recognize a speaker in novel utterances. Yet, the way voice identity is represented in the brain remains poorly understood. We present two adaptation experiments that used novel stimuli generated by auditory morphing of natural voice recordings— voice 'caricatures' and 'anti-voices'— to test specific hypotheses on the representation of voice identity. Experiment 1 provides first evidence for auditory aftereffects in voice identity perception: even brief exposure to a given voice was found to shift identity perception away from that particular voice. This effect was of similar magnitude for caricatures and original voices, suggesting a representation independent of acoustical properties. Experiment 2 reveals for the first time the importance of the average voice in the representation of voice identity. The perceptual shift following adaptation was greater for 'anti-voice' adaptors, i.e. natural voices generated by extrapolation of the average voice in relation to the original voices, than for non-opposite adaptors. These findings provide new insight into the way voice identity is coded in the brain. Prior exposure to different voices shifts the perceptual boundaries previously utilised to define a certain identity. Furthermore, this adaptation effect is not dependent on the voice's acoustical features but on its position relative to a 'prototype' defined by the population average voice.

A35

ADAPTATION REVEALS HIERARCHICAL PROCESSING OF VOICE GENDER Ian Charest[1], Cyril Pernet[2], Pascal Belin[1,3]; [1]Centre for Cognitive Neuroimaging, University of Glasgow, [2]SFC Brain Imaging Research Center, University of Edinburgh, [3]International Laboratory for Brain, Music and Sound Research, Université de Montréal and McGill University — Previous studies identified different brain regions for male and female voices. A more physiologically plausible result of a single brain region decoding for male and female voices was never reported. One possible explanation is the overlap of neuronal populations contributing to gender representation in the Temporal Voice Areas (TVA). Adapting voice gender selective neuronal populations from several presentations of the same gender will allow us to visualise overlapping neuronal populations if they exist. In order to parametrically manipulate the extent of adaptation, a continuous carry-over design with each stimulus being the next one's adaptor was used. BOLD signal was measured in Twenty healthy subjects (10 females). Stimuli consisted of 15 % morph steps from 9 male-female voice continua that were generated using STRAIGHT under Matlab. From the stimulation sequence, a physical value regressor (physical position in its continuum), a physical difference regressor (distance between 2 following stimuli) and a perceptual difference regressor (gender classification distance between 2 following stimuli) were calculated. These regressors were used in a parametric regression approach. A functional localizer of the temporal voice areas was also conducted for each subject. We observed an effect of physical difference in male and female voices in the middle and anterior parts of the superior temporal sulcus in the TVA. Most importantly, we reveal hierarchical processing of voice gender recognition with more abstract representations (effect of perceptual difference) of voice gender in the inferior frontal gyrus, bilaterally.

A36

MODULATION OF MOTOR AREA ACTIVITY DURING OBSERVATION OF HUMAN AND ROBOT ACTIONS Sotaro Shimada[1]; [1]Meiji University — The mirror neuron system (MNS), which is activated when an individual observes the actions of others, as well as when they perform the same action themselves, consists of several sensorimotor areas and plays a crucial role in social cognition. While robot is becoming popular in media entertainment as well as in industrial application, whether the MNS responds similarly to robotic actions compared with human actions is still controversial. The present study investigated whether and how the MNS activity is influenced by appearance and/or kinematics of the observed human and robot action. The left motor area centered at C3 of the 10/20 international system (9 × 9 square cm) was measured using near-infrared spectroscopy NIRS apparatus (OMM-3000, Shimazu). A 2 (appearance: human vs. robot) × 2 (kinematics: human vs. robot) ANOVA showed that there was a strong interaction between these factors, revealing strong deactivations in motor areas when the subject saw a human agent performing robotic actions, whereas the motor area showed positive responses when observing the human agent acting humanly and the robot agent performing robotic actions. These results indicate that MNS activity is sensitive to congruency between the appearance and kinematics of the agent, regardless of whether the agent is human or robot. We suggest that MNS sensitivity to observed action is not innately determined but is acquired through the individual's experiences.

A37

MU SUPPRESSION FOR ACTION OBSERVATION IS CORRELATED WITH EMPATHIC PERSPECTIVE TAKING ABILITIES Jared Hopkins[1], C. Chad Woodruff[1]; [1]Northern Arizona University — Past research suggests the existence of a mirror neuron system (MNS) in humans that may play a role in understanding social interactions (Gallese, et al., 2005). For example, using functional Magnetic Resonance Imaging, Schülte-Ruther et al. (2007) found putative MNS activity in premotor cortex was correlated with empathic abilities of participants. In electroencephalography (EEG), mirror neuron activity is believed to be reflected in the suppression of mu rhythm (8 – 13Hz) typically associated with the sensorimotor cortex (Pineda, 2005; Ulloa & Pineda, 2007). We therefore hypothesized that mu suppression should correlate with a multidimensional empathy questionnaire. We recorded mu suppression from 25 healthy, adult participants during tasks involving action observation and execution of hand gestures, modeled after Oberman et al. (2005). Participants also completed four subscales of the Interpersonal Reactivity Index (IRI; Davis, 1983). Mu suppression values for the action observation task were significantly and positively correlated with the perspective taking subscale of the IRI ($r = .40$, $p = .04$), while mu suppression for the action execution task was significantly and negatively correlated with the personal distress subscale ($r = -.45$, $p = .02$). The theoretical significance of the negative correlation between mu suppression and personal distress is unclear, but the finding of a correlation between action observation and perspective taking is consistent with other cognitive neuroscience findings of MN activation and empathic processing (e.g. Schülte-Ruther et al, 2007) and provides further support for a role of the MN system in empathy.

A38

INFLUENCE OF STATISTICAL REGULARITIES ON EARLY VISUAL MAGNETIC RESPONSE TO FACES Lucile Gamond[1,2,3], Nathalie George[1,2,3], Jean-Didier Lemaréchal[1,2,3], Catherine Tallon-Baudry[1,2,3,4]; [1]Université Pierre et Marie Curie-Paris 6, Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, UMR-S975, Paris, France, [2]Cnrs, Umr 7225, Paris, France, [3]Inserm, U 975, Paris, France, [4]Cenir, Paris, France — Our perception of the world is continuously structured according to current input information as well as prior experiences. In particular, the brain seems very efficient at extracting statistical regularities and this may constitute a general mechanism for the identification of diagnostic stimulus features and the creation of categories (Barlow, 2001; Sloutsky, 2003). Unconsciously recorded regularities seem to influence early visual responses (e.g. Chaumon, Drouet, & Tallon-Baudry, 2008). Our goal was to verify that statistical regularities allows the brain extracting diagnostic features and to investigate at which stage of processing these regularities modulate magnetoencephalographic (MEG) responses to faces. We constructed two face sets that differed only in inter-eyes distance (IED) (small/large). Subjects categorized these faces as flexible or determined. A feed-back was introduced to make the inter-eyes distance diagnostic for this categorization task: the small/large inter-eyes distance faces were consistently associated with the flexible or determined response (counterbalanced across subjects). Subjects were not aware of this statistical regularity and their brain signals were continuously recorded with MEG during pre- and post-feedback phases. The MEG results show that the diagnostic feature of inter-eyes distance has been unconsciously detected. After the feedback phase, there is an amplitude difference in evoked magnetic responses depending on the inter-eyes distance, as soon as 60-85 ms after the face onset. This difference was absent before the feedback phase. This study shows a very early influence of acquired knowledge (here, a co-occurrence between a physical trait and a response) on the visual responses to faces.

A39

THE REAL-TIME LINK BETWEEN PERSON PERCEPTION AND ACTION: BRAIN POTENTIAL EVIDENCE FOR DYNAMIC CONTINUITY Jonathan Freeman[1], Nalini Ambady[1], Katherine Midgley[1], Phillip Holcomb[1]; [1]Tufts University — Much research shows that social perceptions can influence downstream behavior; for instance, priming the category, Elder, leads people to walk slowly. But how does more immediate behavior result from person perception, such as that occurring in social interaction? For instance, how does the perception of a friend's angry face translate into relevant actions across just hundreds of milliseconds? The way the brain extracts information from another's face and then tells the body to react to that information in real-time remains unknown. We investigated this using event-related brain potentials. In Study 1, participants made between-hand sex categorizations of sex-typical and sex-atypical faces. Relative to sex-typical faces, sex-atypical faces evoked negativity between 250-550 ms (N300/N400 effects), reflecting the integration of accumulating sex-category knowledge into a coherent sex-category interpretation. Additionally, the lateralized readiness potential (LRP) revealed that the motor cortex began preparing for a correct hand response while social category knowledge was still gradually evolving in parallel. In Study 2, participants made between-hand eye-color categorizations as part of go/no-go trials that were contingent on target sex. On no-go trials, although the hand did not actually move, information about eye color partially prepared the motor cortex to move the hand before perception of sex had finalized. Together, these findings demonstrate the dynamic continuity between person perception and action, such that partial, ongoing results from face processing continuously cascade into action. The brain starts preparing for action based on tentative perceptions of another's face well before it has completely finished interpreting what it just saw.

A40

PERCEIVING AGE AND GENDER IN UNFAMILIAR FACES: AN FMRI STUDY ON FACE CATEGORIZATION Nadine Kloth[1], Holger Wiese[1], Daniel Güllmar[2], Jürgen R. Reichenbach[2], Stefan R. Schweinberger[1]; [1]Cognitive Neuroscience, University of Jena, Germany, [2]Medical Physics Group, Jena University Hospital, Germany — Whereas the processing of familiar faces is usually characterized by individual identification, efficient processing of unfamiliar faces typically involves categorization (e.g., into old vs. young or male vs. female). However, age and gender categorization tasks may pose different perceptual demands on the face processing system, and thus the underlying neural processes may at least partly differ. In line with this idea, recent evidence from event-related brain potentials (ERPs; Wiese et al., 2008, Psychophysiology) suggests that age but not gender categorization occurs relatively automatically and independent of the task at hand, and may thus need fewer neural resources. In the present study, we employed functional magnetic resonance imaging (fMRI) to compare the activity evoked during age vs. gender categorization of unfamiliar faces. In different blocks, participants were asked to perform age and gender classifications for old or young unfamiliar faces (50% old, and 50% female within each age group). Both tasks elicited activations in a network of regions known to be related to face processing. These included the bilateral fusiform gyrus (fusiform face area, FFA) and bilateral regions at the junction of the occipital and ventral temporal cortex (occipital face area, OFA). Most importantly, and in line with our earlier ERP study, gender categorization as compared to age categorization evoked stronger activation – particularly so in the right FFA and the left OFA. This suggests that gender compared to age categorization imposes higher perceptual demands on the face processing network and thus requires enhanced neural processing.

A42

EXPLORING THE NEURAL ARCHITECTURE OF THE SIMILARITY BIAS IN CULTURAL IMITATIVE LEARNING Elizabeth Losin[1], Marco Iacoboni[1], Mirella Dapretto[1]; [1]University of California, Los Angeles — Imitation is widespread, emerges early in development, and is the means by which we learn critical skills and information such as culturally appropriate behavior and social norms. Imitative learning is biased towards self-similar individuals, likely increasing the adaptive value of learned information, yet the neural underpinnings of imitative learning biases remain unexplored. Two neural systems that may underlie the similarity bias in imitative learning are the mirror neuron system (MNS), which performs perception-action matching, and the medial fronto-parietal system (mFPS), often active during self-referential tasks. In this study, 20 European Americans underwent fMRI while observing and imitating individuals of three ethnicities (European American, Chinese, or African American) and two genders (male or female) performing novel hand actions. We found that higher-order motor regions involved in imitative behavior, including the pre-supplementary motor area and the fronto-parietal components of the MNS, were more active when individuals observed still photos of individuals of their own ethnicity versus another ethnicity, but were more active when they imitated individuals of a different ethnicity versus their own. The precuneus, a parietal region related to self-imagery, was more active when participants observed still photos of, or imitated, their own ethnicity compared to another ethnicity. Finally, the ventral striatum, important for reward processing, was more active when individuals imitated their own versus the opposite gender, regardless of ethnicity. These findings may help explain the neural underpinnings of the self-similarity bias in imitative learning and ultimately inform behavioral modeling strategies used in educational settings, behavioral therapy, and rehabilitation.

A43

WHEN IT'S WRONG NOT TO ACT: HOW THE BRAIN PROCESSES HARMFUL OMISSIONS Fiery Cushman[1], Shauna Gordon-McKeon[1], Dylan Murray[1], Sophie Wharton[1], Joshua Greene[1]; [1]Harvard University — People consider it worse to actively cause harm than to fail to prevent harm. Past research suggests that active harm triggers rapid, automatic moral condemnation. We tested the hypothesis that moral condemnation of harmful omissions relies preferentially on controlled cognitive processes enabled by the dorsolateral prefrontal cortex (DLPFC). Subjects undergoing functional neuroimaging responded to scenarios describing harmful actions (e.g. pushing somebody off a boat to prevent it from sinking) and harmful omissions (e.g. failing to pull somebody onto a boat to prevent it from sinking). As expected, subjects judged harmful actions to be morally worse than harmful omissions. Despite this, a large network of brain regions responded preferentially to omissions. These include regions implicated in representing others' thoughts and behavior (e.g. inferior parietal lobe) as well as regions of DLPFC associated with cognitive control. These effects were often most pronounced among subjects who rated harmful omissions as being comparably bad to harmful actions. This suggests that the condemnation of harmful omissions depends on controlled processes that operate over robust representations of mental states, where the latter reflect the deliberate withholding of aid. Subjects also responded to non-harmful actions (e.g. pushing a barrel off a boat) and non-harmful omissions (e.g. failing to retrieve a barrel). Here, several of the same regions responded more strongly to non-harmful omissions (vs. actions), suggesting that the additional cognitive demands associated with evaluating omissions are not specific to moral judgment. These additional demands may explain why omissions typically receive lesser moral condemnation than actions.

A44

PRIOR MORAL CHARACTER AND FAIRNESS BEHAVIOR IN THE DICTATOR GAME MODULATE NEURAL ACTIVITY, PHYSIOLOGICAL AFFECTIVE RESPONSES, AND PUNISHMENT DECISIONS Lasana Harris[1], Christine Hosey[2], Stefanie Molicki[1], Ernst Fehr[3], Elizabeth Phelps[1]; [1]New York University, [2]University of Chicago, [3]University of Zurich — Both the violator and victim influence third party punishment decisions through different motives; the violator motivates retribution and deterrence, the victim restoration. We show that prior social knowledge about the moral character of both parties in the context of a dictator game, as well as the moral and physiological disgust generated by both parties modulate punishment decisions. In separate samples, we recorded physiological responses using facial electromyography (EMG) and neural responses using functional magnetic resonance imaging (fMRI) while participants punish morally bad or admirable fictitious players for fair or unfair decisions. Four male white neutral faces were paired with real newspaper articles about people performing praiseworthy or blameworthy acts. During the dictator game, a face was assigned to the role of dictator, and another, recipient, on each trial. Dictators were responsible for splitting $1 between themselves and the recipient, either fairly 50:50, or unfairly 90:10. Participants had an opportunity to punish dictators after every decision by entering a value that was subtracted from the dictator's total on each trial. Bad dictators are punished more harshly, and bad recipients restored less. Physiological disgust responses predict punishment amounts when a morally bad dictator behaves unfairly toward a morally good recipient. The behavior replicates in the scanner, and different neural patterns emerge during punishment. These findings dovetail with the existing literature, and add to the growing corpus of research on social and affective factors that affect decision-making in economic games.

Emotion & Social: Self Perception

A45

SELF-FACE RECOGNITION AND SOCIAL CONTEXT Motoaki Sugiura[1], Yuko Sassa[1,2], Hyeonjeong Jeong[1], Keisuke Wakusawa[1,3], Ryuta Kawashima[1,2]; [1]IDAC, Tohoku University, Sendai, Japan, [2]RISTEX, Japan Science and Technology Agency, Kawaguchi, Japan, [3]Tohoku University Graduate School of Medicine, Sendai, Japan — Visual self-recognition has been believed to accompany social self-concept, which in humans entails the representation of one's self in the minds of others. Previous functional imaging studies have, however, predominantly reported self-face-specific activation in the right lateral posterior cortices, which have been implicated in kinesthetic representations of the self body. Involvement of the likely neural substrates of the social self, the medial prefrontal cortex (MPFC), has rarely been reported. We assumed that the involvement of the social self depends on social context. In this study, using functional magnetic resonance imaging, we examined the modulation of neural response to the self-face, a close friend's face, and an unfamiliar face as a control, based on social context. Healthy subjects performed a familiarity judgment of these faces in enriched and poor social-context blocks, in which distracter stimuli were unfamiliar faces and mosaic pictures, respectively. We identified an enhanced response from the ventral MPFC in the enriched social context specifically for the self face. Self-face-specific activation in the right lateral posterior cortices, and self-face-specific deactivation in the bilateral temporoparietal regions, as previously reported, were not affected. Unexpectedly, neural response to the friend's face stimuli in the right lateral posterior cortices was enhanced by the enriched social context. These results were the first to demonstrate the involvement of social self-concept in self-face recognition, as well as the assimilation of the friend to the self in enriched social contexts. Thus the self-other representation is considered to be multicomponent and dynamically modulated by the social context.

A46

NEUROANATOMICAL VARIABILITY OF PERSONALITY Dimitrios Kapogiannis[1], Angelina Sutin[1], Paul Costa[1], Susan Resnick[1]; [1]National Institute on Aging/ National Institutes of Health — We hypothesized that personality, a set of distinctive and recurrent patterns of thoughts, feelings, and actions, is associated with cortical variability. We tested this idea by determining whether the Five Factors of personality (assessed by the revised NEO-Personality Inventory, NEO-PI-R) were associated with variability in regional cortical volume assessed by voxel-based morphometry. 87 healthy adults took the NEO-PI-R and had structural brain magnetic resonance imaging at two timepoints with an average interval of 2 years. Separate regression models were used for analysis of the two time points at the whole brain level and a conjunction analysis was performed to identify replicable associations. Neuroticism was associated with decreased volume of R middle temporal cortex (BA 21); Extraversion with increased volume of L anterior cingulate (BA 24), L middle temporal (BA 21) and L superior frontal (BA 10) cortices and decreased volume of periaquaductal grey matter; Openness with increased volume of R BA 10 and decreased volume of bilateral inferior frontal cortex (BA 47); Agreeableness with increased volume of R inferior and middle frontal cortices (BA 47) and decreased volume of bilateral BA 10 and R superior frontal cortex (BA 22); and Conscientiousness with increased volume within R frontostriatal and bilateral frontoparietal networks and decreased volume of bilateral BA 10 and R middle temporal cortex (BA 21). These findings demonstrate associations between individual differences in personality and cortical variability in brain regions involved in high-order cognitive processing and social cognition.

A47

OPENNESS TO ISOTROPY: A DIFFUSION TENSOR IMAGING STUDY OF PERSONALITY Robert Chavez[1], Rachael Grazioplene[1], Alison Marshall[1], Ranee Barrow[1], Rex Jung[1,2]; [1]The Mind Research Network, [2]The University of New Mexico — One of the most widely studied metrics in human psychology is the five-factor model of personality first proposed by Costa & McCrea (1985). Though certainly not capturing all of the variance in human personality, there is broad consensus that the five personality factors serve as useful representations of the major axes of variation in individual disposition (Nettle, 2006). Recent findings indicate that white matter connectivity measures are predictive of individual differences in novelty seeking and reward dependence (Cohen et al, 2008). Using diffusion tensor imaging (DTI) at 3 Tesla, we hypothesized that fractional anisotropy (FA) would be related to individual differences in personality as measured by the five-factor inventory (NEO-FFI), including Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. The sample consisted of 100 subjects, screened to be free of neurological or psychiatric disorders. Using Tract-Based Spatial Statistics and permutations test, we found the trait of Openness was inversely correlated with FA within large areas of right cerebral white matter with significance ranging from p=.037-.005 . The most significant areas were found in portions of the anterior thalamic radiation, a tract connecting the prefrontal cortex to sub-cortical nuclei. This finding adds to a growing body of literature indicating a relationship of personality to prefrontal connections linking sub-cortical and limbic regions (Buckholtz, 2007). To our knowledge, this is the first report using DTI to investigate the entire five-factor model of personality in a large cohort consisting entirely of normal, healthy subjects.

A48

COMPARING THE NEURAL CORRELATES OF SELF AND OTHER-REFERENTIAL JUDGMENTS: A META-ANALYSIS OF FUNCTIONAL NEUROIMAGING STUDIES Bryan T. Denny[1], Hedy Kober[1,2], Tor D. Wager[1], Kevin N. Ochsner[1]; [1]Columbia University, [2]Yale University — The uniqueness of the self relative to others has long been of great interest to psychologists. In particular, judgments made about the self or about others have been shown to have divergent consequences for memory, affect, and behavior. The advent of functional neuroimaging has allowed for the investigation of the functional neural architecture underlying such judgments, but different studies have shown variability in the specificity and localization of self and other-related activations. We performed a comprehensive meta-analysis of 108 functional neuroimaging studies involving self and other judgments using a multi-level kernel-based approach (MKDA) in order to determine whether the neural correlates of task judgments made with respect to the self or others are reliably different. We were particularly interested in differentiable activation patterns in the medial prefrontal cortex (mPFC), a key component in several theories of how the brain supports self-relevant cognition. We found that dorsomedial PFC activation was reliably associated with making judgments when the target of the judgment was another person relative to the self, whereas judgments made with reference to the self relative to others were associated with more ventral mPFC activation. Further analyses showed that when the self and other conditions were separately compared to a non-mentalizing baseline condition, the resulting activation maps were similar across a broad area from ventral to dorsal mPFC. Region-of-interest analyses were then performed to illustrate these results. These results suggest that self and other-relevant judgments are associated with a specialization gradient moving from ventral to dorsal mPFC, respectively.

A49

FUNCTIONAL NEUROIMAGING STUDY ON PROCESSING OF VIRTUAL AND BIOLOGICAL PERSONS BY ONLINE ROLE-PLAYING GAMERS REVEALS GREATER ANGULAR GYRUS ACTIVITY FOR VIRTUAL SELF THAN FOR BIOLOGICAL SELF AND GREATER ANTERIOR CINGULATE ACTIVATION FOR VIRTUAL SELF THAN FOR BIOLOGICAL OTHER Shanti Ganesh[1], Hein T. van Schie[1], Floris P. de Lange[1], Daniël H. J. Wigboldus[1]; [1]Radboud University Nijmegen — Goal: This fMRI study aims to investigate the effect of psychological perspective (1st, 2nd, 3rd person) and person reality (biological vs. virtual persons) on degree of self-reference as measured by (i) neural self-other overlap in brain areas involved in person processing during encoding and (ii) recognition memory (Northoff et al., 2006). Methods: In an encoding task, twenty-two gamers and 21 matched controls counted syllables or indicated the degree to which trait words were descriptive of self, best friend, the Dutch queen and either avatar (gamers) or favourite cartoon character (controls), while whole brain functional MRI images were recorded. After encoding participants completed a post-scanning surprise recognition task, where they judged whether they had previously seen the word in the scanner. Results: Gamers showed larger neural self-other overlap for avatar than queen, reflected by larger anterior cingulate activity. An interaction effect of person reality x psychological perspective x group revealed larger activity for avatar > self in the left angular gyrus and left superior frontal gyrus (gamers) compared with cartoon > self (controls). Gamers had higher recognition scores for avatar than for queen. Controls did not show differences in neural self-other overlap nor recognition scores between queen and cartoon. Conclusions: These results suggest that not person reality, but psychological perspective determines the degree of self-reference. The finding that a virtual person experienced from a 1st person psychological perspective can overrule neural self-relevance of a biological third person may have important implications for theories on development of the self and identity.

A50

SEEING YOURSELF FACILITATES PERCEPTION OF OTHERS' EMOTIONS Nim Tottenham[1], Yuan Hang Li[1]; [1]UCLA — It has been posited that an intimate link exists between one's own face and the understanding of other people's expressions (Sato &Yoshinkawa, 2007). Much of the literature has focused on how other face processing influences our own face. We expand this view by examining the role of our own face in perceiving others. We hypothesize that there exists an internal self representation that can aid in recognizing emotions in others – one that can be engaged through visual perception of one's own face. Furthermore, this effect should be greatest when sex is constant between perceiver and stimulus. Sixty three (47 female) participants were shown either movies of their own or another's facial expressions in a between-subject manipulation. Then, participants engaged in a recognition task where an initially neutral face morphed into a happy or angry expression. They responded 'angry' or 'happy' as soon as they could detect the emotion. We conducted a 2 (Prime: Self, Other) x 2 (Subject-gender: Male, Female) x 2 (Stimulus-gender: Male, Female) repeated measures ANOVA. We found a significant 3 way interaction in RT that show Self primes resulted in faster emotion recognition when sex was constant between perceiver and stimulus only for male participants. We suggest that self representations are engaged to facilitate in the recognition of emotions in others, specifically for men recognizing male faces. Our results are consistent with past literature that suggest men are typically worse at recognizing emotions; in our case they benefit more from seeing their own faces than women.

A51

SYMPTOM ATTRIBUTION IN FIRST-EPISODE PSYCHOSIS: A CORTICAL THICKNESS STUDY Lisa Buchy[1,2,3], Michael Bodnar[1,2,3], Yasser Ad-Dab'bagh[1], Claude Lepage[1], Alan Evans[1], Karine Sergerie[1,2], Jorge Armony[1,2], Ashok Malla[1,2,3], Ridha Joober[1,2,3], Martin Lepage[1,2,3]; [1]McGill University, Montréal, QC, [2]Douglas Mental Health University Institute, Verdun, QC, [3]Prevention and Early Intervention Program for Psychoses, Verdun, QC — Background: Frontal lobe dysfunction is ascribed a vital role in the pathogenesis of illness misattribution in first-episode psychosis (FEP), and this is conceptualized as the anosognosia/neurological deficit account of poor insight. Whether non-frontal regions are important for illness attribution remains to be established. Further, whether common or separable neural systems underlie attribution of specific symptoms (e.g., delusions, asociality) has not been studied. Method: Cortical thickness analysis was used to identify the neuroanatomical correlates of Scale for assessment of Unawareness of Mental Disorder rated insight in 38 people with a FEP. Results: Misattribution of delusions associated with thinning in the dorsolateral prefrontal cortex (DLPFC, BA9). Misattribution of hallucinations associated with thinning in the left DLPFC (BA9) and left middle temporal gyrus (BA21). Considering blunted affect, misattribution associated with thinning in the bilateral DLPFC (BA9) and left inferior temporal gyrus (BA20). Misattribution of asociality associated with thinning in the left middle frontal gyrus (BA8). Conclusions: The results confirm predictions derived from the nosognosia/neuropsychology account and assert that thickness in frontal cortex is associated with symptom attribution in FEP. That thinning emerged in non-frontal regions in parietal and temporal cortices suggests that the neural signature of insight involves a neural network, and not only the frontal lobes, as previously suggested. The results also provide preliminary evidence for the existence of several insight-related mechanisms hosted in multiple cortical regions, and suggest the existence of separable neural systems underlying attribution of specific symptoms in FEP.

A52

SOCIALLY HYPER-EXPERIENCED GRAPHIC SYMBOL AFFECTS EVALUATIVE PROCESSING OF OUTCOME Shun Itagaki[1], Kazuo Hiraki[1]; [1]The University of Tokyo — Relatively unknown fact is that the "O" (circle) and "X" (christcross) are respectively taken as a "good" sign and a "bad" one in Japan. From when Japanese began to understand things, these links between graphic symbols and meanings were socially or culturally hyper-experienced in daily lives. In this study, we focused on whether neural processing of these links is characteristic or not. Two experiments were conducted to investigate this issue based on the feedback-related negativity (FRN). The FRN is an ERP component which reflects whether the outcome is good or bad. ERPs were recorded during the alternative gambling task, associated graphic symbols with Gain/Loss outcome. In experiment 1, we associated "O"/"X" with Gain/Loss (congruent) and Loss/Gain (incongruent). The result showed that the FRN was elicited by the "Loss" feedback in both conditions. In addition, the FRN in incongruent condition was elicited later than in congruent one. This result suggests that the association between graphic symbols and actual result affects the evaluation with temporary dimension. In experiment 2, we used socially unrelated graphic symbols associated rhombus/hexagon with Gain/Loss (rhombus gain) and Loss/Gain (hexagon gain). The result showed that the FRN was elicited by "Loss", but there was no difference of the FRN between two conditions in terms of latency, suggesting that the congruency between original meaning of typical graphic symbols and actual outcome modulates the evaluation process. We conclude that socially or culturally hyper-experienced graphic symbols have effect on the evaluation of outcome.

A53

DISSOCIATING THE NEURAL REPRESENTATION OF SELF AND OTHER IN AUTOBIOGRAPHICAL MEMORY USING SENSECAM Joseph Moran[1], Daniel O'Young[1], John D. Gabrieli[1]; [1]MIT — The self is a multifaceted topic that is central to human psychology. Functional imaging has identified neural systems that respond preferentially for different facets of self, including the self-concept (medial prefrontal [mPFC] and posterior cingulate [pCC] cortices) and self-recognition (right prefrontal cortex and anterior insula [INS]). Autobiographical episodic memory retrieval is an aspect of the self that shares some task components with those just mentioned (e.g., 'selfness' and introspection). Memory research implicates mPFC and pCC in the retrieval of personally experienced episodes, but the nature of the task precludes comparing self and other. In this experiment we sought to allow comparison of self-and other-generated autobiographical episodic information. Participants (N=15) took pictures using a SenseCam (Microsoft Research, Cambridge, UK), a wearable device that passively records several images per minute through a fisheye lens, which are designed to document the participant's visual experiences. Image streams were then presented to participants at two frames per second in a blocked-design imaging paradigm. In the control condition, participants viewed image streams created by a confederate. Imaging analysis compared Self with Other blocks, and revealed greater activation for self images in regions of pCC, left dorsolateral prefrontal cortex, bilateral INS and bilateral temporoparietal junction. These results suggest that re-experiencing one's own compared to another person's autobiographical memories recruits brain areas involved in integration of information about oneself, episodic memory, and social cognition in general. We speculate that absence of involvement of mPFC may reflect its preferential engagement in semantic aspects of self-reflection.

A54

THE EFFECTS OF EMOTIONAL MUSIC ON MEMORY: AN INTER-DOMAIN COMPARISON William Aubé[1,2], Isabelle Peretz[1,2], Jorge L. Armony[1,2,3,4]; [1]International Laboratory for Brain, Music and Sound research (BRAMS), [2]Université de Montréal, [3]McGill University, [4]Douglas Mental Health University Institute — Emotional expressions have an influence on episodic memory. Within the visual domain, this effect is emotion-specific, resulting in better memory for fearful faces, but in decreased accuracy for sad ones. In contrast, initial findings for nonlinguistic vocalizations suggested a better memory for all emotional expressions, compared to neutral ones. Whether emotion modulates memory for other types of auditory expressions, such as music, remains unknown, despite its powerful ability to elicit emotional responses. Using a within-subject design, we tested recognition memory in 50 healthy subjects in the auditory domain. Each participant listened separately to vocalizations and short musical excerpts (happy, fearful, sad and neutral stimuli) during 2 sessions separated by a few days. Results show an emotional effect of music on memory. Higher accuracy was found for both happy and scary music as compared to neutral and sad music. Previous findings with vocal expressions were replicated, with a memory advantage for all emotional expressions. In addition, a correlation between memory performance for music and vocalizations was found, particularly for expressions of threat, and to a lesser degree, for happy stimuli. This suggests a similar memory pattern in both auditory domains which is consistent with the hypothesis that the emotional pathway of vocal emotions is shared with musical emotions, and possibly mediated by the amygdala.

Language: Lexicon

A55

WHAT DID YOU SAY JUST NOW, BITTERNESS OR WIFE? AN ERP STUDY ON THE INTERACTION BETWEEN TONE, INTONATION AND CONTEXT IN CANTONESE CHINESE Carmen C. Kung[1], Dorothee J. Chwilla[1], Carlos Gussenhoven[2], Sara Bögels[1], Herbert Schriefers[1]; [1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, [2]Center for Language Studies, Radboud University Nijmegen — Previous Studies in Cantonese Chinese showed that the addition of a rising question intonation contour to low tones leads to frequent misperception of these tones (e.g. Ma et al., 2006). Here we explored the processing consequences of this interaction by comparing the processing and identification of monosyllabic critical words at the end of questions versus statements, using a tone identification task and ERPs as an online measure of speech comprehension. Experiment 1 yielded high error rates for the identification of low tones at the end of questions. This difficulty in tone identification prompted a reanalysis to check for a perceptual error, triggering an N400-P600 pattern. In Experiment 2, we investigated the effect of immediate lexical context on the tone by intonation interaction. The context was created by locating the monosyllabic critical words at the second position of two-word compounds, so that the lexical tone of these words became highly predictable from the preceding part of the compound. This contextual constraint led to a huge reduction in errors and a disappearance of the P600-effect. The overall results indicate that there is an immediate interaction between tone, intonation, and context. The difference in activation patterns between the two experiments highlights the significance of context in understanding a tone language, such as, Cantonese-Chinese. It also provides further support for the monitoring hypothesis of language perception (e.g., Kolk & Chwilla, 2007), which states that the P600-effect reflects a general reanalysis to check for input processing error when a strong conflict occurs.

A56

LEXICAL ACCESS IN YOUNG, YOUNGER-OLD AND OLDER-OLD ADULTS: AGE-RELATED CHANGES IN THE CONTRIBUTION OF PHONOLOGY AND SEMANTICS Meredith Shafto[1], Billi Randall[1], Paul Wright[1], Lorraine Tyler[1]; [1]University of Cambridge — Although most aspects of language comprehension are well-preserved in old age, some findings suggest that age affects the trade-off between conceptual and perceptual processing, with older adults relying relatively more on semantic than phonological information during lexical access (e.g., Speranza et al., 2000).This may be reflected in changes to the neural underpinnings of lexical access, a possibility in keeping with evidence that older adults' preserved comprehension is accompanied by compensatory recruitment (Tyler et al., 2009). Thus, changes in neural sensitivity to phonological or semantic factors in old age may reveal whether increased reliance on semantic information reflects declines in phonological processing. We tested this hypothesis by manipulating phonological (cohort competition) and semantic (imageability) variables in a lexical decision task while young, younger-old and older-old participants were in the fMRI scanner. Young and younger-old adults replicated a previous behavioural finding that semantic information assumes greater functional significance as it becomes more difficult to discriminate between phonologically similar words (Tyler et al., 2000). However, older-old adults were sensitive to semantic information even when words were relatively phonologically unique. This age effect was reflected neurally in that young and younger-old but not older-old activated left inferior frontal gyrus (LIFG) during word processing, and this activity was sensitive to phonological discriminability. Older-old adults did not activate LIFG, instead demonstrating sensitivity to semantic availability in a region in left middle temporal gyrus (LMTG). These findings suggest that older adults become less able to access phonological representations, instead maintaining comprehension by relying on available semantic information.

A57

EFFECTS OF AGING ON LEXICAL AMBIGUITY PROCESSING Ekaterini Klepousniotou[1], Emma Woods[1]; [1]Institute of Psychological Sciences, University of Leeds, UK — The present study investigated age-related differences in lexical ambiguity processing by focusing on the effects of sentential context on the processing of multiple meanings of four types of ambiguous words, namely balanced and unbalanced homonymy, metonymic and metaphorical polysemy. Twenty young (10 female) and twenty older (10 female) healthy adults participated in a cross-modal semantic priming experiment. Ambiguous words were incorporated in dominant- or subordinate-biasing sentence primes followed after a short (100 ms) interstimulus interval by dominant-meaning related, subordinate-meaning related or unrelated target words. Overall, there were no effects of aging as similar performance was observed for both young and older healthy adults. In particular, for balanced and unbalanced homonymy as well as metaphorical polysemy, there were significant effects of context in that there was facilitation for contextually appropriate meanings only. In contrast, for metonymic polysemy, there were limited effects of context as both dominant- and subordinate-related targets were facilitated in both dominant and subordinate contexts, possibly due to the high degree of the interrelatedness of the two senses. The findings indicate that the multiple meanings of homonymous, metaphorical and metonymically polysemous words are affected differentially by biasing contexts and that these accessing differences possibly point towards representational differences. Finally, the present results indicate that healthy aging does not affect the processing of lexical ambiguity.

A58

THE PUTATIVE VISUAL WORD FORM AREA SHOWS NO PREFERENTIAL ACTIVITY FOR WORDS AND LETTERS DURING NAMING AND MATCHING TASKS Alecia Vogel[1], Steven Petersen[1], Bradley Schlaggar[1]; [1]Washington University in St. Louis — A region in the left fusiform cortex has been termed the "visual word form area" (vWFA), due to reported preferential activity for words and letters that is position, case and size independent (Cohen & Dehaene 2004). However, increased BOLD activity for other types of visual stimuli has also been shown (Price and Devlin, 2003). We tested whether the vWFA is preferentially tuned for letter and word processing. Typical adult subjects read aloud words and nonwords (containing either legal or illegal letter combinations). Subjects also made same/different judgments on pairs of these stimuli, consonant strings and Amharic character strings (Ethiopian writing system). Finally, subjects named single letters and pictures, and made same/different judgments on pairs of these stimuli and single Amharic characters. No region in the left fusiform showed preferential activity for words, strings, or letters. Several regions near the classical vWFA (-42/-54/-12) were found in item-type x time analyses of the whole brain, but showed greater activity for less "word-like" stimuli. For example, all left fusiform regions showing an effect of string-type in the matching task demonstrated higher activity for Amharic than letter strings, while regions showing an effect of item-type in item naming showed more activity for pictures than letters. When vWFA coordinates were applied, there was no difference between item-types in any of the tasks. We conclude that the left fusiform cortex, including the putative vWFA, shows no preferential word or letter activity in the context of tasks that emphasize visual processing or visual-to-phonological and/or semantic interaction.

A59

LANGUAGE EFFECTS IN SECOND LANGUAGE LEARNERS: A LONGITUDINAL ERP STUDY Laura Soskey[1], Katherine J. Midgley[1,2], Phillip J. Holcomb[1], Jonathan Grainger[2]; [1]Tufts University, Medford, MA, [2]LPC-CNRS, Marseille, France — Are the mechanisms involved in word recognition in early L2 learners different from those of more proficient L2 users and how do these mechanisms evolve during learning? Our study sought to closely track language effects in beginning learners of an L2. In the present study both behavioral and ERP data were collected to investigate the changes over time of L2 processing in beginning learners. Monolingual L1 English-speakers enrolled in introductory Spanish at Tufts University were first trained on a list of 228 Spanish words and their English translations. These critical items were chosen from the vocabulary to be learned in their Spanish class over the course of the semester. Behavioral data from this training session and the following experimental sessions showed expected learning effects. In the three subsequent experimental sessions the participants saw 3 lists – an English list, a Spanish list, and a mixed language list, performing a go/no-go lexical decision task. As observed in previous studies our results showed overall larger negativities in the N400 epoch to L1 items than to L2 items. The differences varied in that amplitudes in the traditional N400 epoch to L2 items became more negative over the course of the semester. Comparisons between items in the pure lists and the mixed lists demonstrated differences in amplitude as well as in timing of the N400 effects. The results will be discussed within the framework of current models of language acquisition.

A60

AUDITORY COMPREHENSION OF IDIOMATIC PHRASES: AN EVENT-RELATED FMRI STUDY Kathleen Brumm[1], Matthew Walenski[2,3], Frank Haist[2], Tracy Love[1,2,3]; [1]Joint Doctoral Program, Language and Communicative Disorders, SDSU/UCSD, [2]UCSD, [3]School of Speech, Language, and Hearing Sciences, SDSU — While left hemisphere neural regions are traditionally assumed to underlie most aspects of language comprehension, recent neuroimaging studies suggest bilateral neural engagement while reading idiomatic phrases (Lauro et al., 2008, Zempleni et al., 2008). We investigated the neural substrates of comprehension for idiomatic phrases embedded in auditory sentences by employing event-related BOLD FMRI. Forty ambiguous idioms were chosen, such that each had a plausible literal or figurative interpretation. Idioms were three words long, with the form V + NP (i.e. ring a bell). We constructed minimal pair sentences for each idiom (80 items total)—where one version disambiguated the phrase towards its literal meaning (1), and one disambiguated the phrase towards the idiomatic meaning (2). The matched sentences were identical except for the disambiguating phrase immediately following the idiom. Items were counterbalanced across two lists. (1) The friendly librarian didn't ring a bell to quiet the students at the conservative college. (2) The friendly librarian didn't ring a bell to the quiet students at the conservative college. Preliminary results (n=3 to date; additional data collection/analysis is ongoing) from FMRI analyses time-locked to the onset of each idiom indicate greater right hemisphere cortical activation for idiomatic- (2) than literal-biased (1) sentences in STG (BA22) and MFG (BA6). For the literal-biased, however, there was greater left hemisphere cortical activation in IPL (BA40). Our results via auditory presentation concur with prior findings of bilateral neural involvement during comprehension of literal and figurative language, but suggest hemispheric specialization for different aspects of language comprehension.

A61

PASSIVE WORD LEARNING WITHIN MINUTES: BRAIN CORRELATES OF RAPID MEMORY TRACE FORMATION Yury Shtyrov[1], Vadim Nikulin[2], Friedemann Pulvermuller[1]; [1]Medical Research Council (MRC), Cognition & Brain Sciences Unit, Cambridge, UK, [2]University Medicine Berlin, Germany — Contrary to traditional research into long-term memory formation that concentrates on learning-induced changes over days or weeks of practice, we looked into immediate plastic changes caused in the brain by passive perceptual learning. Our subjects were presented with spoken words and pseudowords in passive oddball experiments (~150 rare deviant and ~800 frequent standard trials). Monosyllabic stimuli in each block differed only in their final consonant, and both acoustic and lexical contrasts were kept constant across conditions. The subjects' EEG was recorded using high-density whole-scalp array. We then scrutinised evoked responses on a trial-by-trial basis, and investigated changes in these responses over the experimental session. Whereas the brain response to deviant words was large throughout the experiment (with a weak trend towards an amplitude decline over time), that to deviant pseudowords increased dramatically, being small at the start and large at the end of a 15 minute experimental session. Robustness of pre-existing word memory traces with moderate habituation of their activation as opposed to the apparent formation of new memory circuits for previously unknown pseudowords appear to be the most likely causes of these effects. As to our knowledge, this is the first report of a neurophysiological manifestation of rapid word learning as it is well-known to take place in infancy and in second language acquisition. We discuss implications of this new finding for the neurobiological theory of language and the underlying brain dynamics at the neuronal circuit level.

A62

LANGUAGE EFFECTS IN VISUAL WORD RECOGNITION BY TRILINGUALS : AN ERP STUDY Xavier Aparicio[1,2], Jonathan Grainger[2], Katherine J. Midgley[3], Phillip J. Holcomb[3], Jean-Marc Lavaur[1]; [1]Université Montpellier Sud de France, [2]Université de Provence - Aix-Marseille, [3]Tufts University — Are the basic mechanisms of word recognition similar for one's first language (L1) and subsequent languages (L2, L3…)? Do these basic mechanisms differ as a function of language dominance? The present research used electrophysiological measures to compare evoked brain responses in visual word recognition for the three languages of trilingual participants. All participants were native French speakers (L1), with English as a second language (L2) and Spanish as a third language (L3). Participants monitored a series of words from their three languages, blocked by language, for occasional probes from one semantic category, Event related potentials (ERPs) were recorded to non-probe critical items. The pattern of ERP waveforms was similar for the three languages. However, the three languages differed mostly in the amplitude of the N400 component. Analyses of the ERP data showed an effect of language in the traditional N400 window. French (L1) words showed a larger N400 amplitude compared with both English (L2) and Spanish (L3). English and Spanish, on the other hand, showed very little differences in this time window. However there was some evidence for differences between these two languages in an earlier time window. We examine how these results fit with different possible extensions of models of bilingual processing to the case of trilingualism.

A63

DISSOCIATING LATE ACQUISITION FROM FLUENCY: LINEAR MIXED-EFFECTS MODELLING OF PROFICIENCY AND N400 AMPLITUDE IN NATIVE AND LATE LEARNERS OF ENGLISH Aaron Newman[1], Antoine Tremblay[2], Helen Neville[3], Michael Ullman[2]; [1]Dalhousie University, [2]Georgetown University, [3]University of Oregon — Findings of more "native-like" (L1-like) brain activation patterns during adult second language (L2) processing in higher- than lower-proficiency L2-learners are complicated by confounds between learner status (L1vs. L2) and proficiency, since even high-proficiency L2 learners generally have lower proficiency than L1 speakers. The common practice of dichotomizing the continuous variable of proficiency into somewhat arbitrary categories of high and low proficiency has increased the difficulty of teasing apart these factors. Additionally, many studies do not formally assess proficiency at all. We sought to address these issues. We recorded event-related brain potentials (ERPs) to lexical/semantic violations in L1 English speakers and in L2 learners of English (native Spanish speakers, age of acquisition at least 18 years). English proficiency was measured with a standard test (TOAL-3) in all subjects. Although proficiency was higher in the L1 than L2 group, the groups showed proficiency overlap. Linear mixed-effects modeling was used to identify main effects and interactions between learner status and proficiency on N400 amplitude and onset. The N400 in response to semantic violations showed a larger amplitude and earlier onset in L1 than L2 learners. There was also a main effect of proficiency on onset, with higher proficiency (over L1 and L2) associated with earlier N400 onset. There was no main effect of proficiency on amplitude. Finally, an interaction between learner status and proficiency on amplitude (no interaction on onset) was driven by larger N400 amplitudes in higher- than lower-proficiency L1 speakers, with no effects of proficiency within the L2 group.

A64

THE KILOWORD PROJECT: A LARGE SCALE INVESTIGATION OF THE INFLUENCE OF LEXICAL DEMOGRAPHIC VARIABLES ON EVENT-RELATED POTENTIALS Janelle LaMarche[1], Phillip J. Holcomb[1], Jonathan Grainger[2], Stephane Dufau[2]; [1]Tufts University, MA, [2]LPC-CNRS, University of Provence, Marseilles, France — The effects of several variables that have previously been purported to influence lexical processing were investigated using event-related potentials (ERPs). A large corpus of words (~1,000) was presented to 100 subjects (50 using lexical decision and 50 using semantic categorization). Most previous studies have used fewer particpants and/or fewer words. We conducted detailed time-course analyses of ERPs contrasting a number of lexical demographic variables, including mean bigram frequency, rated familiarity, concretenes, and orthographic neighborhood size, word length and frequency. A host of effects, some starting as early as 180ms, differentiated the ERPs to words in the different conditions. The results will be discussed in terms of models of lexical processing.

A65

THE EFFECT OF FORCED LEXICAL ACCESS DURING NAMING TASKS ON FMRI BOLD ACTIVATION IN THE VENTRAL AND DORSAL VISUAL PROCESSING STREAMS Jacqueline Cummine[1], Carrie Esopenko[2], Josee Amyotte[1], Gordon E. Sarty[2], Ron Borowsky[2]; [1]University of Alberta, [2]University of Saskatchewan — Background: Past research indicates that the ventral visual processing stream is active during lexical reading, as evidenced by imaging experiments that include exception word and regular word naming tasks. However, the extent to which the lexically-based ventral stream is active for naming words under varying task demands is less understood. Purpose: We explored functional Magnetic Resonance Imaging (fMRI) activation in the ventral and dorsal visual processing streams, for high and low frequency exception words and regular words, during two reading paradigms: go no-go naming and basic naming. The go no-go naming paradigm forces lexical access prior to naming and thus should evoke more ventral activation than the basic naming paradigm, which does not require lexical access prior to naming. Method: Participants named words aloud in either a go no-go naming paradigm or in a basic naming paradigm. FMRI activation maps that separate unique versus shared regions of activation were created. Results: We found that the go no-go naming task produced activation that was primarily restricted to the ventral visual processing stream (e.g., occipito-temporal gyri). In contrast, the basic naming task produced activation in the ventral and dorsal (e.g., superior frontal gyri) processing streams. Conclusion: We provide evidence that the go no-go naming task that forces lexical access does indeed increase activation within the ventral visual processing stream. In contrast, the basic naming task, which does not require the same level of constrained responses, produces a broader activation pattern as compared to the go no-go naming task.

A66

ERP MASKED PRIMING IN TWO DIFFERENT JAPANESE SCRIPTS Kana Okano[1], Jonathan Grainger[2], Phillip Holcomb[1]; [1]Tufts University, [2]LPC - CNRS — Research using roman script languages has shown a series of effects consistent with hierarchical interactive models of visual word processing. However, the generality of these findings to non-roman script languages are unclear. The present study examined the time-course of processing in two different Japanese scripts (Hiragana and Katakana) using an ERP masked priming paradigm. In the first experiment, Japanese speakers read Hiragana and Katakana target words in separate blocks preceded by the same or an unrelated masked prime word displayed for 50ms. The masked primes were in the same script as the target or a different script. Similar to previous ERP masked priming studies, Japanese speakers showed within- and cross-script repetition priming on the N250 and N400 components for Hiragana targets, but no such effects were observed for Katakana targets. In a follow-up study, the same paradigm was run with an 80ms prime duration. In this experiment Japanese speakers showed within- and cross-script repetition priming on the N250 and N400 components in both Hiragana and Katakana targets. These results suggest that Hiragana words are processed similarly to roman script words, but that Katakana words are likely processed via a different mechanism.

A67

AN ERP STUDY ON BEGINNING SECOND LANGUAGE LEARNING Yen Na Yum[1], Katherine J. Midjley[1,2], Jonathan Grainger[2], Phillip Holcomb[1]; [1]Tufts University, [2]LPC - CNRS — In the initial stage of learning to read a second language (L2), the visual configuration and the meanings of the words are acquired, often in relation to the first language (L1). Although this is usually accomplished quickly, it can be challenging when the L2 is in a different writing system than the L1. With a combination of behavioral responses and ERP data, the present study tracked how beginning L1 French and L1 English learners acquired the word form and meaning of Chinese characters in four experimental sessions. At the beginning and end of each session, participants performed a repetition detection task to facilitate word form familiarization. Participants were then trained with a set of 84 single Chinese characters and their L1 translations, and performed a forced choice test with the L1 translations as prime and a choice of two characters. Although participants initially had no experience with Chinese, test performance was at 97% by the fourth session, indicating successful acquisition. Results showed systematic changes in several ERP components across the sessions. An early posterior positivity between 200-400ms was attenuated with increased experience, and N400-like effects emerged over posterior regions for learned L2 words. These effects tended toward similarity to those observed in more proficient learners and might indicate changes in orthographic and semantic processing during L2 learning. These results could be interpreted as markers of early gradual changes in L2 processing. These results will be discussed within the framework of recent models of bilingual lexical processing.

A68

PERCEIVING MANNER- AND PLACE-OF-ARTICULATION CONTRASTS IN SPEECH: AN MMN STUDY Sonia Cornell[1], Aditi Lahiri[2], Carsten Eulitz[1]; [1]University of Konstanz, [2]University of Oxford — To fully grasp the mechanisms of speech perception we have to understand more about the fine structure of stored lexical information. The present study was designed to query the notion of underspecification as a basic principle in storing phonological information in the mental lexicon. Previous neurobiological studies have mainly shed light on the underspecification of certain place-of-articulation features. Here our focus is on manner-of-articulation. Moreover, the contrast sensitivity in different featural dimensions was compared. We examined the brain's automatic change-detection responses to nonword pairs differing in medial consonants [edi], [eni], [ezi] and [egi] using Mismatch Negativity (MMN). Assuming abstract underspecified representations, the varying consonants are predicted to evoke symmetric MMNs for the [ezi]~[eni] reversal (bi-directionally conflicting manner features), and for the [egi]~[eni] reversal (conflicting manner in one direction and conflicting place in the reversed case), but asymmetric MMNs for the reversal of the [edi]~[eni] contrast due to the underspecification of the phonological feature [PLOSIVE] for /d/. The observed pattern of MMNs supported these predictions. Combined place and manner conflicts resulted in MMN differences suggesting an enhanced contrast sensitivity for manner-of-articulation changes.

A69

ORTHOGRAPHIC KNOWLEDGE AFFECTS THE PROCESSING OF UNATTENDED SPOKEN WORDS: MISMATCH NEGATIVITY EVIDENCE Chotiga Pattamadilok[1], Hélène Lafontaine[1], Cécile Colin[1], José Morais[1], Régine Kolinsky[1,2]; [1]Université Libre de Bruxelles, Belgium, [2]Fonds de la Recherche Scientifique-FNRS, Belgium — Several behavioral and brain imaging studies provide strong evidence for the influence of orthographic knowledge on active and high-level speech processing tasks even when written words are not simultaneously presented. No studies, however, have successfully shown that such influence could be observed in a passive speech processing situation, i.e., when participants were not required to attend to speech. In the present study, the Mismatch Negativity, a specific ERP component that is an automatic index of experience-dependent auditory memory traces, was used to investigate this issue. An ''odd-ball'' sequence of acoustic stimuli consisting of frequent-standard words /pu/ (spelled "POU") and infrequent-deviant words /mu/ (spelled "MOU", thus orthographically congruent) and /nu/ (spelled "NOUS", thus orthographically incongruent) was presented to 15 participants in two speech processing situations: passive listening (participants watched a silent movie) and active listening (participants performed a semantic categorization task). Both deviant words elicited a typical MMN over the frontal regions (~80-180ms), reflecting automatic discrimination of standard and deviant stimuli. Interestingly, only in the passive listening situation, the MMN waveform elicited by the orthographically incongruent deviant word (/nu/) showed more negative peak amplitude and mean amplitude and larger surface than the MMN waveform elicited by the orthographically congruent deviant word (/mu/). In the active listening situation, the same differences between the two deviant conditions were found much later: from 400 ms onwards. These findings suggest that orthographic knowledge qualitatively changes the nature of the auditory memory traces. Once reading is acquired, the "phonological" representations might become "phonographic" representations.

A70

ENGAGING FRONTO-TEMPORAL BRAIN SYSTEMS WITH DERIVATIONAL MORPHEMES: AN FMRI STUDY OF ARABIC Sami Boudelaa[1], Mirjana Bozic[1], William Marslen-Wilson[1]; [1]MRC-Cognition & Brain Sciences Unit, Cambridge, UK — Neuroimaging evidence regarding linguistic complexity in Indo-European languages suggests that inflectional complexity (walked, smoked) engages a left-lateralized front-temporal network, while derivational complexity (darkness, warmth) is less effective in doing so. This may reflect the less predictable semantics of derived forms which, unlike inflected forms, lend them less readily to decomposition. This interpretation is consistent with overt priming where derived forms prime if their relationship is transparent (departure-depart), but not if opaque (department-depart). The same tasks reveal strong priming, however, between derived words in Semitic languages regardless of semantic transparency. This dissociation between morphological decomposition and semantic compositionality predicts the engagement, for these languages, of the left-lateralized fronto-temporal system even for derivational complexity. We tested this prediction using three sets of single spoken Arabic words varying in their degree of morphological complexity: (a) words which do not have an internal morphological structure ([lakinna] however), (b) words which encorporate the typical Semitic derivational processes of interleaved root and word pattern ([juluus] sitting), and (c) words which have in addition an inflectional enclitic affix ([firaaruhum] their escape). These were contrasted with a matched complex auditory baseline that does not trigger a speech percept. Morphologically structured words engage a left-lateralized fronto-temporal network, which the words with enclitics engage more strongly. Derivational complexity allies itself with inflectional complexity and more generally with syntactic complexity in languages where morpho-phonological decomposition is divorced from semantic compositionality. These divergent cross-linguistic patterns underline the necessity of studying typologically different linguistic systems to achieve explanatory neurocognitive language models.

A71

ATTENTIVE AND NON-ATTENTIVE PROCESSING OF MORPHOLOGICALLY COMPLEX WORDS AND PSEUDOWORDS: A COMBINED EEG AND MEG STUDY Alina Leminen[1,2], Miika Leminen[2,3], Minna Lehtonen[4,5,6], Päivi Nevalainen[7], Sari Ylinen[2], Lilli Kimppa[2], Christian Sannemann[1,3], Teija Kujala[2], Jyrki Mäkelä[7]; [1]Cognitive Science Unit, University of Helsinki, Finland, [2]Cognitive Brain Research Unit, University of Helsinki, Finland, [3]Finnish Centre of Excellence in Interdisciplinary Music Research, Finland, [4]Helsinki Collegium for Advanced Studies, University of Helsinki, Finland, [5]Åbo Akademi University, Finland, [6]Low Temperature Laboratory, Helsinki University of Technology, Finland, [7]BioMag Laboratory, Helsinki University Central Hospital, Finland — It has been suggested that visually presented complex words such as 'worker' and 'bananas' are automatically parsed into their constituents during comprehension. However, less is known about the neural processing of spoken complex words. The current study investigated the effect of attention on the processing of spoken inflected ('bananas') and derived ('worker') words. Simplex words ('bride') were used as controls. Attention was manipulated by including two experimental tasks: passive and active. EEG and MEG responses were recorded simultaneously from 14 participants. In the passive task condition, the participants were instructed to ignore the incoming auditory stimuli and concentrate on a silent cartoon. In the active task condition, the participants judged whether the stimuli were acceptable Finnish words or not. The order of the task conditions was counterbalanced across participants. The MEG source localization was performed with Minimum Current Estimates (MCE). In the active task, a larger negativity effect and stronger left superior temporal cortex (STC) activation was elicited for inflected words than for derived words. There were no differences in the N400 effect or left STC activations between simplex and derived words. In the passive task, there were no differences in N400 effect between derived and simplex words, but smaller negativity for inflected words. Larger left STC activation was observed for derived than for inflected words. The results show that morphological parsing might require conscious attention. The active task revealed that derived words seem to require less computational capacity than inflected words, which is in line with previous behavioral studies.

A72

ERP EFFECTS FOR MASKED WORD PRIMES Marianna Eddy[1], Danielle Lopez[2], Phillip Holcomb[2], Jonathan Grainger[3]; [1]Massachusetts Institute of Technology, [2]Tufts University, [3]CNRS and University of Provence — In masked repetition priming paradigms, the influence of the prime stimulus on target processing is typically examined. Because of the close temporal proximity of the prime and target it is difficult to disentangle the processing related to only the prime. In this experiment, we presented masked word and word-like stimuli for 50ms followed by a 20ms backward mask, like in a typical masked priming paradigm, however, no target stimulus followed the backward mask. This allowed us to examine the ERP time course of recognition of masked primes without being obscured by target processing. We found an extensive amount of processing takes place with even a 50ms prime exposure. The non-word conditions (consonant strings, false fonts) all differed from the real words starting at 200-300 ms continuing from 300 ms until 400 ms potentially indicating a difference in orthographic and phonological processing respectively. The pseudoword condition differed from the word condition early on (200-300 ms), but this difference was not significant during a late time window (300-400ms). Pseudowords also differed from consonant strings and false fonts from 300-400ms, suggesting a difference in mapping to a phonological representation. The results of this study demonstrate even when a prime is briefly presented and masked, a substantial amount of orthographic and phonological information is activated.

A73

USE IT OR LOSE IT: SECOND LANGUAGE ATTRITION IN BRAIN LOOKS LIKE ACQUISITION IN REVERSE Ilona Pitkanen[1], Lee Osterhout[1]; [1]University of Washington — Second language (L2) learned in adulthood is thought to be notoriously vulnerable to forgetting, but not much is known about the neural events that take place during L2 attrition. Here we report that novice adult L2 learners' brain activity, as measured by event-related potentials (ERPs), showed systematic changes to ungrammatical L2 stimuli during first year of instruction. Crucially, after instruction had ended, the same stimuli elicited identical ERP response changes, but in reverse order. English speakers learning Finnish read Finnish words, orthographically legal non-words and illegal non-words while ERPs were measured in three sessions during first year of instruction and in a follow-up session after instruction had ended. The illegal stimuli were formed by violating Finnish vowel harmony which prohibits co-occurrence of front and back vowels in a word. Legal non-words enhanced the N400 effect (Bentin, 1987) in all recording sessions. Illegal stimuli initially elicited an N400-like effect which was replaced by a P600 effect (Osterhout & Holcomb, 1992) in later sessions during instruction. In the follow-up session, the size of P600 to illegal stimuli was negatively correlated while the N400 size was positively correlated with number of days since instruction ended, indicating that in the absence of instruction, P600 was replaced by an N400. These results suggest that the neural processes underlying some aspects of L2 attrition may involve a similar but reverse developmental path to the one observed during acquisition. L2 grammatical knowledge, reflected by the P600, may be especially vulnerable to attrition in novice learners.

A74

ELECTROPHYSIOLOGICAL EVIDENCE FOR MORPHEME-BASED COMBINATORIC PROCESSING Robert Fiorentino[1]; [1]University of Kansas — Although there is increasing evidence for the decomposition of visually-presented complex words (e.g., "teacup") into their constituent morphemes (e.g., "tea"/"cup"), the nature and neural bases of the combinatorial processes that operate on these mental representations remain unclear. In the current study, we present electrophysiological evidence suggesting morpheme-based combinatorial processing from EEG and MEG recordings obtained during a concurrent visual lexical decision task. The stimuli included sets of 95 known compound words (e.g., "teacup"), novel compound words (e.g., "tombnote"), long words without complex structure (e.g., "throttle"), and novel non-words without real morpheme parts (e.g., "blenyarp"). The stimuli were matched on whole-word properties including length, orthographic neighborhood, and for known words, frequency. Moreover, the known and novel compounds were matched on morpheme properties including length, neighborhood and frequency. Across-condition comparisons revealed separable responses tracking the activation of the constituents of known and novel compounds and the post-decompositional (compositional) processes involving their constituents, prior to, and dissociable from, the eventual overt lexical decision response. The findings converge with previous psychophysical results suggesting the across-the-board processing of known and novel complex words in terms of their morphological constituents, and with previous electrophysiological studies suggesting constituent activation effects within the first half-second of visual word recognition. Crucially, the current findings also propose a measure of the post-decompositional integrative processing of complex word constituents. Together, the findings support a model of complex word processing involving the initial segmentation of the whole-word into potential constituents, the activation of these constituents, and their combination into a complex representation.

A75

INFLUENCE OF EMOTIONAL CONNOTATIONS ON WORD ACQUISITION Thore Apitz[1], Christian Dobel[1], Pienie Zwitserlood[2], Markus Junghoefer[1]; [1]Institute for Biomagnetism and Biosignalanalysis, University of Muenster, Germany, [2]University of Muenster, Germany — We investigated how emotional connotations underlying words' concepts affect the integration of novel words into pre-existing lexical and conceptual memory networks. Participants learned a set of 100 pseudowords as new denotations for 50 aversive (e.g. syringe, tank) and 50 neutral objects (e.g. bottle, chair) using a statistical learning paradigm. Based on a pilot study, objects were chosen from a huge database with respect to optimal, univocal labeling. Over the course of five learning sessions at consecutive days, each visually presented pseudoword was frequently paired with a picture of one specific object and infrequently with pictures of ten different objects. Subjects had to decide via button press if the presented word might match the object. Accuracy of decision increased from chance level to 90% after the fifth session. Whole head Magnetencephalographic event-related fields were recorded as participants read the pseudowords prior to and after the learning sessions. Underlying neural activity was estimated using the L2-Minimum-Norm-Least Squares method. Comparisons of event related brain activity to pseudo word presentation before and after learning showed enhanced sensory activity for aversively conditioned pseudo-words in the time range of the "Early Posterior Negativity" i.e. 200 to 300 ms after word onset, in left parieto-occipital regions. These results demonstrate that newly acquired emotional words evoke brain responses similar to those found for adjectives or nouns with arousing content.

A76

REVISITING NEURAL REPRESENTATIONS OF NOUNS AND VERBS IN CHINESE USING FMRI Xi Yu[1], Yanchao Bi[2], Zaizhu Han[2], Sam-Po Law[1]; [1]The University of Hong Kong, [2]State Key Laboratory of Cognitive Neuroscience and Learning — Most earlier studies claiming different neural correlates of nouns and verbs were based on comprehension and/or production of action and object names unmatched on imageability in brain-injured and normal individuals (Bird et al., 2000). More recently, some have argued the noun/verb difference can be reduced to one in morphological paradigm (Tyler et al., 2008). This raises the question of whether different neural representations of nouns and verbs exist in languages with impoverished inflectional morphology, e.g. Chinese. Li et al. (2004) addressed the issue using a lexical decision task with materials matched only on frequency and character complexity, and found no regions specifically activated for nouns or verbs. Interesting as they may seem, their observations may not be relevant as lexical decisions do not necessarily require conceptual or morphosyntactic processing. In our study, we focused on noun and verb processing at the conceptual level using a semantic-relatedness judgment task and stimuli, single-character and two-character words, matched on frequency, imageability, age-of-acquisition, and number of stroke. Our results based on 15 native speakers of Mandarin Chinese in Beijing showed that, although many common brain regions were activated by both word classes, the left inferior temporal gyrus was more activated in noun processing, and the left middle and superior temporal gyri in verb processing. We further found greater verb than noun activation in the left frontal area (BA 44, 47) in ROI analysis. We conclude that conceptual processing of nouns and verbs in a language with few morphosyntactic morphemes still activates different cortical areas.

A77

ELECTROPHYSIOLOGICAL EVIDENCE OF THE SEMANTIC AND PHONOLOGICAL ENCODING IN MANDARIN PRODUCTION AND COMPREHENSION Yi-Shiuan Chiu[1,2], Li-Chiun Tsai[1]; [1]Fu Jen Catholic University, Taipei, Taiwan, R.O.C., [2]Laboratory for Cognitive Neuropsychology, National Yang-Ming University, Taipei, Taiwan, R.O.C. — The psycholinguistic debates of serial and parallel models in language production and comprehension were investigated by a non-alphabetic language, Mandarin. Two event-related potential (ERP) components were used to explore the time course of semantic and phonological encoding during picture naming and word comprehension in Mandarin. The components of the lateralized readiness potential (LRP) and N200 were presumably related to response preparation and response inhibition. In the language production tasks, participants were shown the pictures and made dual choice go/nogo decisions based on semantic features (animate or inanimate) and different phonological features (end phonemes in experiment 1, and the phonological length in experiment 2). The results showed that the pick latencies of the N200 were significantly earlier in these two go/nogo = phonology condition than in the go/nogo = semantics condition. The nogo LRP was found only in the go/nogo = end phonemes but not in the go/nogo = number of phonemes, suggesting the cascade process in Mandarin production. In the comprehension tasks, the decisions were based on semantic features (animate or inanimate) and different phonological features (initial phonemes in experiment 3, and end phonemes in experiment 4). The results suggested the serial process and semantics prior to phonology in Mandarin comprehension. In conclusion, the electrophysiological findings indicated the semantic word property was available earlier than the phonological features when participants produce and read single words. Furthermore, the language comprehension process is not just the reverse pattern of the production model.

A78

IMMEDIATE AND DELAYED EFFECTS OF NOVEL WORD ACQUISITION BEFORE AND AFTER NOCTURNAL SLEEP - A MEG-STUDY OF LANGUAGE PLASTICITY Annuschka Eden[1], Pienie Zwitserlood[1], Gareth Gaskell[2], Christian Dobel[3]; [1]University of Muenster, Germany, [2]University of York, United Kingdom, [3]Institute for Biomagnetism and Biosignalanalysis, University of Muenster, Germany — Immediate and delayed neurophysiologic and behavioural effects of word acquisition in adults were investigated. A statistical word-learning-training was implemented, consisting of 40 acoustic pseudo words, paired seven times with matching and seven times with mismatching objects. One group performed the training in the morning (am-group), another in the evening (pm-group) while magnetoencephalographic (MEG) brain responses were measured. MEG responses to matching and mismatching combinations were measured again 12 and 24 hours after training. L2 Minimum norm estimates were calculated to determine the sources of the brain signals. A typical N400m response indicated a clear progress during training with differences between correct and incorrect stimulus-pairings after four presentations which was confirmed by behavioural responses. Neural networks mediating these integration processes were found within the left temporal lobe, an area typically described as one of the main generators of the N400 response. An addition, there emerged expected differences between groups at the second session. The pm-group exhibited a leap of progress from session one to two while the am-group showed this behaviour from session two to three. Thus confirming earlier behavioural results, consolidation of novel word learning seems to be associated with a time-interval crucially involving sleep.

A79

TASK-EFFECTS ON EARLY BRAIN RESPONSES IN VISUAL WORD RECOGNITION REVEALED BY EEG/MEG Yuanyuan Chen[1], Matt Davis[1], Friedemann Pulvermuller[1], Olaf Hauk[1]; [1]Medical Research Council Cognition and Brain Science Unit, Cambridge, UK — Electrophysiological data on the time course of visual word recognition are still quite inconsistent, with estimates for latencies of different processing stages varying by several hundreds of milliseconds. This discrepancy may be partly attributed to the tasks used. The current study used combined EEG/MEG to investigate responses to single words in silent reading (R), lexical decision (LD) and semantic decision (SD) in the same group of subjects. Sensor analysis and MNE source estimation revealed that brain activation was comparable across tasks until about 150ms, when the three tasks began to differ. MNE analysis revealed a spread of activation from occipital to temporal and inferior frontal brain areas within 250 ms in all tasks. Task-related differences were most pronounced in inferior frontal brain areas. Preliminary analysis of several specific psycholinguistic variables using multiple regression (Length/N, Lexical Frequency, Bi/Trigram Frequency, Concreteness/Imageability, Action-relatedness, Number of Meanings/Senses) indicated that multiple processing stages already occur less than 300 milliseconds after stimulus onset. The absence of early (~100ms) differences between tasks demonstrates that the level of general attentional demands is similar across tasks, and in particular that silent reading produces reliable brain responses without requiring overt responses. Our data suggest that task-relevant information is retrieved around 150 ms, providing further evidence for early lexico-semantic processes in visual word recognition.

A80

LEXICAL REPRESENTATION OF NOUNS AND VERBS IN THE LATE BILINGUAL BRAIN Jing Yang[1], Li Hai Tan[2], Ping Li[1]; [1]Pennsylvania State University, [2]University of Hong Kong — Neuroimaging studies of lexical representation in English suggest that basic lexical categories such as nouns and verbs are represented by different brain circuits. By contrast, research from Chinese indicates that nouns and verbs involve common neural patterns of activation. How are nouns and verbs of two different languages organized in one brain, that is, in bilingual speakers who have representation of lexical categories in both languages? The present study investigates the neural representation of nouns and verbs in late Chinese-English bilinguals using fMRI. During fMRI scanning subjects were asked to make a lexical decision task to English words (or nonwords) and disyllabic Chinese words (or nonwords). In the baseline condition, they were told to judge the direction of arrows. Data analyses revealed that, consistent with previous research on monolingual Chinese speakers, there were no significant differences between Chinese nouns and verbs. Both nouns and verbs evoked neural responses in the left middle frontal cortex and posterior temporal-parietal regions. Interestingly, these late Chinese-English bilingual subjects also showed no systematic differences in brain activation patterns for English nouns and verbs, except that English verbs elicited stronger activation in the left middle frontal cortex and bilateral temporal-occipital regions. The findings from the current study are consistent with our previous studies of both monolingual Chinese and early bilingual Chinese-English speakers. Together, these studies provide support for the hypothesis that neural circuits for languages are shaped both by language-specific properties and by the learner's specific experiences with first and second languages.

A81

LEXICAL PROCESSING IN BILINGUAL BRAINS: TRANSLATION EQUIVALENTS Laura Sabourin[1], Christie Brien[1]; [1]University of Ottawa — Research on the organization of language and how it is processed in the bilingual brain is an important aspect of not only understanding linguistic processes but also very important for understanding neural organization in general. It is currently debated whether bilinguals and language learners make use of one single lexicon (containing words from both their languages), or whether they have separate stores for words from each language. The present experiment investigates lexical processing in English-French bilinguals by using behavioural and event-related brain potential masked priming techniques to investigate semantic and translation priming effects. Masked priming, which has provided evidence for early, automatic semantic priming effects in monolingual populations (Grossi, 2006), has also been used to investigate the possible existence of one large lexicon for items in both languages, or whether separate lexicons exist for each language. Results show that the earlier the L2 is acquired the more likely that one lexicon is used to store items from both languages. With this data we are getting close to being able to determine at what stage in the lifespan maturational changes may affect the neural organization of lexical storage.

A82

EARLY AUTOMATIC PROCESSING OF DERIVATIONAL AND INFLECTIONAL FORMS IN SPOKEN WORD COMPREHENSION: COMBINED MEG-EEG EVIDENCE Caroline Whiting[1], Yury Shtyrov[1], William Marslen-Wilson[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge UK — Recent studies suggest that the presence of a potential stem and affix within a word (corn-er) is sufficient to trigger attempts at its decomposition, regardless of semantic compositionality. Using combined magneto- and electroencephalography, we investigated how the processing of spoken words is modulated by such morpho-phonological cues. The mismatch negativity (MMN), a well-known index of long-term linguistic memory traces, was recorded to examine the spatiotemporal neural dynamics elicited by words of varied complexity: transparent derivational affixation (baker), pseudo-affixation (beaker), inflectional affixation (bakes, beaks) and non-affixed forms, in the absence of focused attention. Matched pseudowords were used as acoustic and phonological controls. A critical variable was semantic transparency within the derivational set, where the embedded stem is related or unrelated to the meaning of the whole form (baker vs. beaker). Results revealed an initial peak approximately 150-200ms after the deviation point with a major source in left supratemporal cortex. This early component was sensitive not only to lexicality - showing a larger response to real words than pseudowords - but also to morphological structure, with a significant increase for a potential but invalid segmentation (beak-er). A later component at 250-300ms following the deviation point showed differential processing for word conditions containing a suffix, but not for the non-affixed endings. Finally, the N400-like component indicated increased activation for pseudowords, but showed no morphological sensitivity. These results support recent theories pointing to early and automatic processing based on the presence of phonological cues to morphological structure.

A83

ERP EVIDENCE FOR MASKED TRANSLATION AND ASSOCIATIVE PRIMING EFFECTS IN HIGHLY PROFICIENT BALANCED BILINGUALS Jon Andoni Dunabeitia[1], Maria Dimitropoulou[1,2], Itziar Laka[3], Manuel Carreiras[1,3]; [1]Basque Center on Cognition, Brain and Language, [2]University of La Laguna, [3]University of the Basque Country — In a first study, we examined whether there is symmetrical masked translation priming effects in a group of balanced simultaneous Basque-Spanish bilinguals using event-related brain potential recordings. Participants were presented with Spanish and Basque words that could be preceded by their repetitions (identity condition), by their translations in the other language, or by unrelated words (Spanish and Basque). Results showed a significant masked repetition effect, mainly evident in the N250 and N400 components. Importantly, a masked translation priming effect was also found in the N400 component, being the magnitude of the N400 modulation similar for both language directions (L1-to-2 and L2-to-L1). In a second study, a bilingual group of the same characteristics completed an ERP masked priming experiment in which they were presented with Spanish targets that could be preceded by semantically related Spanish and Basque words (by means of word association), or by semantically unrelated Spanish and Basque words. Within-language associated word pairs and between-language associated pairs showed a modulation of the N400 component, as compared to within- and between-language unrelated word pairs. Furthermore, language switch cost effects were also found in the two studies, confirming that masked primes that do not match targets' language elicit more negative-going N250 and N400 deflections. These studies represent the first piece of evidence of neural responses guiding unconscious and automatic word translation and word association processes in balanced simultaneous bilinguals, and confirm the predictions of models of bilingual word processing and bilingual memory.

A84

MORPHOLOGY IS NOT REDUCIBLE TO THE COMBINATION OF SEMANTICS AND ORTHOGRAPHY: A PRIMING TASK FOR FRENCH VERBS Phaedra Royle[1,2,3], Karsten Steinhauer[3,4], John E. Drury[3,4], Nicolas Bourguignon[1,3]; [1]Université de Montréal, [2]CHU Ste-Justine, [3]CRLMB, [4]McGill University — Morphological aspects of language processing have been suggested to be reducible to the combination of formal (phonological or orthographic) and semantic effects. We tested this idea in a priming study using event-related potentials (ERPs) and lexical decision. Target words were inflected French verbs and were preceded by either unrelated control words or one of three prime-types: Morphological: cassait – CASSE 'broke – break'; Formal: cassis – CASSE 'blackcurrant – break'; and Semantic: brise – CASSE 'break – break'. Primes were presented very briefly (50 ms) with a forward and backward mask. We expected this procedure (based on prior literature) to eliminate semantic priming while retaining formal and morphological priming, which could then be compared directly. Twenty-two native French-speaking right-handed adults (18 to 35 years old) with (corrected to) normal vision participated in the experiment. The EEG was recorded continuously from 19 standard electrodes and was analyzed as event-related potentials (ERPs) time-locked to the target verbs. As expected, there were no significant behavioral or ERP semantic effects, while both morphological and formal priming were observed. Though the ERP patterns for these two conditions were quite similar, the morphological effects persisted ~100 ms longer than the formal effects. This presence of a distinct ERP pattern for morphological versus formal priming in the absence of any semantic effects is inconsistent with models that reduce morphology to "semantics + orthography" and is consistent with the view that morphology is a valid theoretical construct for descriptions of lexical and linguistic processing.

A85

PROCESSING LEXICAL COMPLEXITY IN POLISH: BEHAVIOURAL AND NEUROIMAGING EVIDENCE Zanna Szlachta[1], Aleksandra Jelowicka[1], Mirjana Bozic[1], William Marslen-Wilson[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK — Different types of lexical complexity in English modulate the involvement of different fronto-temporal language networks during language comprehension (Bozic et al., 2007). Morpho-phonological complexity (regularly inflected verbs, jumped) activates left-lateralised inferior frontal areas, while increased general processing complexity (words with onset-embedded stems, clay-claim) engages front-temporal areas bilaterally. In this initial study we ask whether Polish, with its much richer inflectional system, can be shown to observe similar neuro-cognitive contrasts. We used passive listening efMRI and auditory lexical decision experiments to investigate parallel types of lexical complexity in Polish. For nouns we contrasted uninflected (e.g. dom – house), case-inflected (e.g. dom-u – house, genitive) and onset-embedded (e.g. kotlet – cutlet) conditions. For verbs we co-varied number of alternate stem forms (2 or 4) with number of inflectional choices. Behaviourally, nouns showed differing latencies according to apparent complexity; with inflected nouns slowest and simple nouns fastest. Imaging data, in contrast to English, did not differentiate these noun conditions. For verbs we saw no effects of inflectional complexity in either imaging or lexical decision. Multiple stem forms, however, elicited lower latencies in lexical decision and were correlated with a reduction in neural activation in the left superior and middle temporal gyri, relative to verbs with fewer stem forms. This facilitation by multiple stem forms of the same verb may be analogous to the processing advantage for words with multiple senses (Rodd et al., 2002). Lexical processing in morphologically complex languages like Polish may differ substantially from less complex languages like English.

A86

CHARACTERIZING LEXICAL COMPLEXITY COMPUTATIONS IN THE FRONTO-TEMPORAL LANGUAGE NETWORK Mirjana Bozic[1], Li Su[1], Cai Wingfield[1], William Marslen-Wilson[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge UK — Bilateral fronto-temporal systems play a key role in speech comprehension. Evidence suggests that their activation is modulated by variations in the lexical complexity of the incoming input. General processing demands for linguistically simple words (e.g. dark) activate a bilateral subsystem, while combinatorial processes reflecting the presence of linguistic complexity (e.g. regular inflectional morphemes, play+ed) engage a left hemisphere perisylvian subsystem (Marslen-Wilson & Tyler, 2007). We applied Representational Similarity Analysis (RSA; Kriegeskorte et al, 2008) to establish information content and test the type of computation performed in fronto-temporal areas during processing of these different input types. Consistent with findings from univariate analyses, results showed that combinatorial processes triggered by the presence of inflectional suffixes (-ed) produce inter-correlated patterns of representation in left pars triangularis (BA45). Competition between multiple candidates for lexical access (e.g., in words with embedded stems, claim-clay), which increase general processing demands, correlated with the representation pattern in bilateral pars orbitalis (BA47). In a follow-up study we varied combinatorial and general processing demands in both inflected and derived words (e.g. played vs bravely), to test further how different complex inputs modulate the computations performed in fronto-temporal areas. The results show that inflected and derived words present different challenges for the speech processing system, and suggest a dynamic modulation of the type of computation performed in different linguistic contexts. This novel approach to studying language comprehension allows more precise characterization of the information carried and processed in the fronto-temporal language network.

A87

SPATIOTEMPORAL DYNAMICS OF MORPHOLOGICAL PROCESSING: AN MEG/EEG INVESTIGATION Elisabeth Fonteneau[1], Mirjana Bozic[1], Billi Randall[2], William Marslen-Wilson[1]; [1]MRC - Cognition and Brain Sciences Unit, Cambridge, UK, [2]Experimental Psychology, University of Cambridge, UK — Different aspects of spoken word processing are differentiated within the neural language system. Linguistic complexity engages primarily left lateralised processes, whereas general processing complexity - as indexed by lexical competition - engages a more bilateral network (Tyler et al., 2005). To track the spatiotemporal dynamics of these systems we combined magneto-encephalography (MEG) and event-related brain potentials (ERPs) in an auditory study. Participants listened to lists of words that varied on two different dimensions and occasionally performed a 1-back memory task. Linguistic processing complexity was manipulated by the presence of a potential inflectional morpheme (played, trade). General processing complexity was engaged by the presence of onset-embedded lexical competitors (claim, hump). Results indicate magnetic and electric field differences between the two types of processing complexity from 250 ms and extending until 510 ms post stimulus and maximally distributed on the anterior left part of the scalp. Source estimates computed with MNE (L2, minimum norm estimates) and analysed using regions-of-interest suggest that general processing complexity activates selectively right inferotemporal posterior areas from 350 ms, as the evidence builds up for the presence of an embedded stem. By contrast, linguistic processing elicited stronger activation in left middle temporal and posterior sources from 450 ms, linked to the timing with which the inflectional ending starts to be heard. These results support a spatiotemporal distinction between processes corresponding to different types of lexical processing complexity.

A88

CONTEXTUAL WORD LEARNING – A MEG STUDY Kati Keuper[1], Pienie Zwitserlood[1], Antoni Rodríguez-Fornells[2], Ludger Elling[3], Christian Dobel[3]; [1]University of Münster, Germany, [2]Faculty of Psychology, University of Barcelona, Spain, [3]Institute for Biomagnetism and Biosignalanalysis, University of Münster, Germany — The meaning of a new word in a foreign language can be derived from context, similar to L1 acquisition during infancy. Accordingly, Mestres-Misse et al. (2007) had participants learn the meaning of novel words by embedding them in intelligible sentences. They observed a brain response related to lexical and semantic processing (N400) that changed along with learning progress. The present study intended to replicate this finding, and to identify the neural generators by means of advanced magnetencephalographic source-reconstruction techniques. Fifteen healthy German native speakers performed contextual novel-word learning. Each item occurred in the final position of three consecutive plain text sentences (triplets). These either implied one shared meaning for the novel word (congruent context) or disparate meanings for each sentence of a triplet (incongruent context). Thus, a novel word´s meaning emerged with its repeated exposition. Stimulus-related brain responses were recorded. Learning progress was verified by various behavioral measures. We observed a significant decline of the brain response over widespread cortical regions as a function of the repeated exposure to the novel word in a 200-600 ms time range. As expected, first presentations showed no difference between congruent and incongruent contexts. Significant differences emerged for third presentations: Novel words in the congruent condition caused smaller neural responses. We discuss our data in relation to prior findings mentioned above.

A89

ACQUISITION OF PRELEXICAL CUES OF A FOREIGN LANGUAGE: EVIDENCE FROM A LONGITUDINAL ERP STUDY Sonja Rossi[1], Tobias Hartmueller[1], Hellmuth Obrig[1,2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]University Hospital Leipzig, Germany — Phonotactics is one prelexical cue which comes into play during the acquisition of a foreign language since a native English speaker will classify a word starting with 'bz' as phonotactically illegal. These rules, which define the possible combination of different phonemes in a given language, need to be altered when he or she learns Slovak, since a word starting with 'bz' is legal in Slovak phonotactics. Here we investigate how such phonotactic rules are acquired and which neurophysiological correlates of such a plastic change are observable. Two kinds of pseudowords were acoustically presented to German native speakers while the EEG was recorded: pseudowords phonotactically legal in German were compared to pseudowords phonotactically illegal in German. The illegal pseudowords, however, corresponded to a language unknown to the subjects, the Slovak language. The experiment comprised pretest, training, and posttest sessions on three consecutive days. Two training strategies were compared. One group of subjects underwent an "implicit training", by passively listening to novel phonotactic rules. The second group of subjects took part in an "explicit training", in which their focus was explicitly directed to the phonotactic rules to be learned. In line with previous results from our group (Rossi et al, submitted) the critical ERP component (N400) was larger for legal compared to illegal pseudowords. With regard to the plasticity of the language system across the different testing sessions a modulation of the N400 effect for trained and untrained items was present suggesting differential neuronal processing mechanisms while learning prelexical cues.

A90

ERP MEASURES OF L1 LEXICAL ATTRITION IN BENGALI-ENGLISH SPEAKING INDIVIDUALS Hia Datta[1], Valerie Shafer[1], Loraine Obler[1], Mira Goral[1,2], Martin Gitterman[1,2]; [1]The Graduate Center, CUNY, [2]Lehman College, CUNY — Individuals who use two or more languages over their lifespan experience change in these languages depending on the dynamics of how they are used (Kopke, 2004, Goral et al., 2008). Attrition is a phenomenon where one's first language (L1) changes from the more stable language to a more volatile, inaccessible language due to interference from the stronger second language (L2). Using a lexical cross-modal and cross-linguistic picture-word priming paradigm, we investigated lexical access in two groups of Bengali-English speaking individuals who are dominant in their L1 and L2 respectively. Words were presented in 1) two conditions a) semantically matched: where the pictures and the auditory words matched and b) semantically mismatched: where the pictures did not match the auditory words, and 2) two languages a) English b) Bengali. Event related potentials, recorded from 64 scalp sites, demonstrated that our Bengali-English L2-dominant participants, compared to the L1-dominant group, were more sensitive to the English semantically mismatched words than the Bengali ones. Results are discussed in the context of lexical attrition in L2-dominant participants living in their second language environment.

A91

ERP CORRELATES OF ORTHOGRAPHIC NEIGHBORHOOD EFFECTS USING THE LEVENSHTEIN DISTANCE Marta Vergara-Martínez[1], Tamara Swaab[1]; [1]University of California, Davis — One of the assumptions in theories of visual word recognition is that the presentation of a word activates similar words at orthographic, phonological or semantic levels. The impact of orthographic neighbors on word reading has allowed for a better understanding of the time course of orthographic information in lexical access. However, visual word recognition studies using Coltheart's orthographic neighborhood size criteria (N: number of words that can be derived from another word by changing one letter in a specific position while keeping the number of letters constant) do not account for recent research investigating other types of neighbors (deletion, addition or transposition). Moreover, N is very restrictive with large length words. To further investigate the neural bases of orthographic processing, in the present study we used Levenshtein Distance and manipulated orthographic similarity over high and low frequency words of different lengths. Event Related Potentials (ERPs) were recorded while participants read words in a semantic categorization task. Our results for short words showed frontal N400 neighborhood effects in low frequency words: larger negativities were obtained for large compared to small neighborhoods. This pattern of results was not observed for long words. We interpret our results in terms of larger activation of orthographic/semantic representations for high neighborhoods and discuss alternative measures of orthographic similarity for understanding the mechanisms underlying word reading.

A92

NEUROANATOMICAL ORGANIZATION OF SPEECH AS REFLECTED BY THE MISMATCH NEGATIVITY RESPONSE McNeel Jantzen[1], Jonathan Adams-Moore[1], K.J. Jantzen[1]; [1]Western Washington University — Presence of the mismatch negativity indicates automatic cerebral processing of acoustic and/or phonological properties (Näätänen & Winkler, 1999). Phillips (2001) proposed that there are three levels of speech representation, acoustic, phonetic, and phonological. Further, Zeftawi (2005) found that the encoding of acoustic information occurs earlier than the encoding of both the phonetic and phonological information of the speech signal. Finally, Hickok and Poeppel (2000) suggest that speech perception is strongly lateralized to the left hemisphere with two distinct pathways involved in the process. One is inclusive of the temporal-parietal-occipital junction and is accessed when the mental lexicon is needed. The second involves inferior parietal and frontal areas and is used for access to sub-lexical speech segments. We addressed the following questions to determine whether the location of the mismatch negativity was indicative of acoustic, phonetic, or phonological processing of the speech sound: 1) Does perceptual training improve the mismatch negativity amplitude in the temporal and frontal areas 2) How does the neural representation of the speech signal compare to the behavioral results when a perceptual mapping procedure is performed. Fourteen subjects were trained over a five-day period to identify a voiced, unaspirated, dental stop consonant. Days one and five consisted of a perceptual mapping procedure and an electrophysiology mapping. Behavioral results show that training improved subjects' ability to perceive the non-native contrast. Training effects and organization of perceptual features was reflected in the mismatch negativity response as observed by location of the mismatch negativity, increased duration and decreased onset latency.

A93

LEARNING LANGUAGE LATERALITY AND THE MOTOR SYSTEM Friedemann Pulvermuller[1], James Kiff[1], Yury Shtyrov[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge — Is language laterality inborn or a consequence of learning? Our data show that learning, specifically the binding of sound information to articulatory patterns, plays an important role. Right-handed monolingual subjects learned spoken phonologically regular nonsense words over several sessions and EEG brain responses were recorded for new and learned items. In a perceptual learning condition, subjects were asked to listen to the nonsense words and in an articulatory learning condition, subjects were required to repeat each nonsense word after presentation. After learning, brain responses were enhanced to learned words as compared with new, not previously encountered ones. The degree of enhancement was similar in both learning conditions, but was left-lateralized only in the articulatory learning condition. Source localization indicated early (220 ms) co-activation of superior-temporal and precentral cortical sources when words learned in the articulatory task were recognized. Superior-temporal but no motor systems activation was seen for items learned in the passive perceptual learning task. Our results suggest that language laterality can be learned and that auditory-articulatory links, reflected in superiortemporal-prefrontal coactivation, are critical for learning language laterality.

A94

COGNITIVE AND BRAIN REORGANISATION FOR READING AFTER NEUROSURGERY Sarah Lippe[1], Ghislaine Dehaene-Lambertz[2], Marie Hully[3], Georg Dorfmuller[4], Catherine Chiron[5], Lucie Hertz-Pannier[3]; [1]CHU Ste-Justine Research Center, University of Montréal, Psychology, Montréal, [2]Unité INSERM 562 CEA/NeuroSpin, [3]Laboratoire de Recherche Biomédicale (LBIOM) NeuroSpin I2BM/DSV CEA, [4]Fondation Ophtalmologique Adolphe de Rothschild, [5]Inserm u663 Hôpital Necker-Enfants Malades — In contrast to language, brain plasticity of reading is weakly explored. Here, using neuropsychological testing and functional MRI (fMRI) we describe the evolution of reading abilities in a child with focal epilepsy caused by a gliotic lesion whose resection was undertaken at 12 years of age (left cuneus, pre-cuneus and occipital pole). Full neuropsychological evaluations were performed one year before and 2 months after the surgery. Partial neuropsychological evaluations as well as fMRI for words, faces, houses and checkerboard perception were performed 4 months before and 4 months after the surgery. 80 full brain images were acquired on a 3T Siemens scanner(TR2400 TE30). The neuropsychological results revealed postsurgery deficits in reading, visuo-spatial memory and visuo-motor coordination, but spared attention. Reading regressed from a 2 years, 2 month delay before the surgery to a 5 year, 9 month delay 4 months after the surgery. Before the surgery, fMRI showed a specific activation to words in the left temporo-occipital (-48 -57 -15) (FDR $p < 0.048$) region, which functionally disappeared post-surgically. After the surgery, right occipital (27 -99 5mm corrected $p < 3.2502e-004$) and left temporal lobe (-39 -3 -27mm uncorrected $p < 0.006$) activations were enhanced by all visual stimuli. A new neural network for reading could have emerged after the left neurosurgery, however, recruitment of the right occipital and left temporal regions were not specific to reading. These results support the importance of the left occipito-temporal network for reading and reveal its robustness in the context of developmental lesions.

Long-Term Memory: Other

A95

SLEEP TO MEMORIZE INTENTIONS FOR THE FUTURE Susanne Diekelmann[1], Ines Wilhelm[1], Ullrich Wagner[1,2], Jan Born[1]; [1]University of Luebeck, Germany, [2]Bangor University, UK — Memories are of the past but serve to regulate future behavior. Prospective memory is the unique human ability to remember executing an intended action or plan at some designated point in the future. Sleep is well known to benefit the consolidation of memories for past events. The prospective aspect in memory, however, has been largely ignored in sleep and memory research. Here, we show that sleep after forming an intention is essential to execute the intended action after a delay of two days, benefiting both remembering that something has to be done and remembering what has to be done. We further confirm that this effect is bound to active sleep-associated processes occurring during slow wave sleep, and not REM sleep, going beyond passive protection against interference. This enhancing effect of sleep on prospective memory was nullified when the intended action was executed already before sleep and thus was not further active during sleep. These findings suggest that sleep selectively benefits those memories that are relevant for future behavior. By strengthening the intentional memory representation, sleep enhances the probability that the intended action is executed at the appropriate time in the future.

A96

FMR-ADAPTATION AS AN ONLINE MEASURE OF UNITIZATION IN ASSOCIATIVE RECOGNITION Rachael Rubin[1], Neal Cohen[1], Brian Gonsalves[1]; [1]University of Illinois, Urbana-Champaign — The current study investigated the process of creating unitized representations of separate items, a process that has been hypothesized to allow associative recognition to be supported by item rather than relational memory, and thus by brain regions other than the hippocampus. A difficulty with research on unitization has been establishing when unitization of separate items has occurred, in a way that does not rely on inferences from memory outcomes. Here, unitization was encouraged during the initial presentation of novel objects by manipulating whether two objects moved together, and thus may be perceived as a single object, or moved separately, and thus may be perceived as separate objects. Immediately following a 4-second movie of either of these two movement conditions, a static version of the fused object was presented. Differences in peak activity in the combined BOLD response to the movie and static image were compared between conditions in which the same visual form was presented throughout the duration of the trial to conditions in which different variants of the visual form (e.g. non-unitized variants) were presented during the trial. It was predicted that a match between the visual forms in the trial would produce maximal adaptation while a mis-match between the visual forms in the trial would produce recovery from adaptation. Preliminary results (n=8) revealed evidence of adaptation in response to unitized items but not non-unitized items bilaterally in the fusiform cortex.

A97

FUNCTIONAL SIGNIFICANCE OF N170 AS REVEALED BY WILLIAMS SYNDROME: CORRELATION WITH MEMORY FOR FACES IN A GENETIC SYNDROME CHARACTERIZED BY ENHANCED ATTENTION TO FACES Inna Fishman[1], Anna Yam[1,2], Rowena Ng[1], Ursula Bellugi[1], Debra Mills[3]; [1]The Salk Institute for Biological Studies, [2]University of Florida, [3]Bangor University — The present study examined whether event-related potentials (ERP) patterns linked to the processing of faces are correlated with memory for faces, in individuals with Williams Syndrome (WS) and typically developing controls (TD). ERPs were recorded as participants viewed pictures of faces displaying happy, fearful or neutral expressions, and scrambled face stimuli. Using spatiotemporal Principal Component Analysis (PCA), a N170 and a frontal positivity (P200) were identified. For N170, no significant group effect was found (i.e., both WS and TD exhibited comparable amplitudes of N170). However, within groups, the N170 was modulated by affect in TD, but not in WS, such that it was the largest for Fear, followed by Happy and the smallest for Neutral faces. Next, the PCA-derived components were correlated with the participants' performance on a standardized test of memory for faces (Wechsler Memory Scale, Faces Subscale). The N170 amplitude was correlated with performance on the Delayed Recall task in the WS group only, such that the larger (more negative) the N170, the better was their memory for faces. This relationship was not found in the TD group. In contrast, the frontal P200 was positively correlated with performance on the Immediate Recall in the TD group, but not in WS. These results suggest that, in WS, the early perceptual stage of face processing – manifested on scalp by N170 – contributes to, or is a part of the same algorithm that underlies their enhanced memory for faces, and is likely instrumental in the "hypersociability" associated with WS.

A98

THE SEGREGATION OF SEMANTIC REPRESENTATION AND RESOURCE ALLOCATION IN NUMBER PROCESSING Yi-Fang Hsu[1], Dénes Szücs[1]; [1]University of Cambridge — Repetition suppression observed in the adaptation paradigm is considered as the indicator for the nature of representations across different stages of a processing stream. It is reported in numerical cognition research tackling the automatic access to numerical magnitude as the adaptation paradigm enables the separation of response from representation. However, the time course in which the brain discriminates numerical magnitude in an automatic manner remains unclear. The lack of temporal information makes it difficult to determine whether the effects found in previous studies reflect the semantic analysis of numerical magnitude or some domain-general processes. This study used ERP adaptation to reveal the unfolding mechanisms involved in the automatic activation of numerical information. We found that ERP amplitudes between habituation/deviant stimuli differed at four time windows. We also found that ERP amplitudes triggered by the deviant stimuli per se were modulated by the numerical distance between habituation/deviant stimuli at three time windows. While the effect at earlier time windows is comparable to the ERP numerical distance effect reported in previous studies, the effect at later time windows seems to reflect the P3 amplitudes difference between conditions. The results suggest that the brain can discriminate numerical magnitude by around 150-200 ms in the absence of response requirement. Moreover, numerical information in the adaptation paradigm seems to modulate participants' resource allocation. Our finding that the modulation of numerical magnitude reflects a mixture of different mechanisms challenges the one-to-one link between the parametric effect of numerical distance and the semantic analysis of numerical magnitude.

A99

MATCH-MISMATCH PROCESSES BEYOND THE HIPPOCAMPUS Jonathan P. Shine[1], Andy C. H. Lee[2], Kim S. Graham[1]; [1]Wales Institute of Cognitive Neuroscience, School of Psychology, Cardiff University, UK, [2]University of Oxford, UK — Using a match-mismatch paradigm, Kumaran and Maguire (2007) showed increased activity in the left hippocampus (HC) for temporal and location changes (mismatches) compared to when these were repeated (match). By contrast, the right HC coded the presence of objects in familiar locations. We asked (a) whether these effects could be replicated when there was no demand to remember over repeated trials, (b) whether they were affected by stimuli (object versus scenes) and (c) whether they extended to other medial temporal lobe (MTL) regions. Participants viewed two grids (2 x 3) each containing 3 trial-unique items (scenes, objects or shapes) and indicated whether these were same (match) or different (mismatch – different item location or different item). The right HC showed a preference for objects and scenes that were presented in the same location, while left HC exhibited an increase in activity for both types of mismatch (particularly for object compared to scene location mismatches). Perirhinal cortex (PrC) showed a consistent preference for objects over scenes (across all conditions), with a trend towards greater activation to item, compared to location, mismatches (left PrC). Parahippocampal place area (PPA) demonstrated a preference for scene, compared to object, stimuli, with right PPA more active during both object and location mismatch trials and left PPA more active for scenes presented in the same location. The findings reveal that the PPA, as well as the hippocampus, contributes to match-mismatch detection, and that the role of the hippocampus in novelty detection is modulated by stimuli type.

A100

EFFECTS OF VOLITIONALLY CONTROLLED VISUAL EXPLORATION ON MEMORY AND BRAIN-NETWORK DYNAMICS Joel Voss[1], Brian Gonsalves[1], Kara Federmeier[1], Neal Cohen[1]; [1]Beckman Institute — Choices must be made during learning regarding what to study and when, and the cognitive and neural determinants of these choices are poorly understood. We manipulated the extent to which individuals could control their visual exploratory behavior while learning the locations of objects and found that volitional control is a major determinant of learning outcome. Volitional control (choosing which objects to view and when) was associated with marked benefits for both item recognition and spatial recall relative to passive control (directing attention to specified objects at specified times). Furthermore, volitional control produced beneficial effects on memory by coordinating the activity within a brain network centered on the hippocampus and including cortical structures involved in memory, attention, cognitive control, and object identification. Distinct patterns of network activity were associated with volitional benefits to spatial versus item-specific memory. Volitional benefits to spatial recall were associated with increased correlations between hippocampus, prefrontal cortex, and inferior cerebellum, whereas volitional benefits to item recognition were associated with increased correlations between hippocampus, parahippocampal cortex, and lateral parietal cortex. These results collectively indicate that actively directing the learning process benefits memory by organizing neuroanatomically distinct cognitive operations such that memory representations that evolve with time can guide new learning.

A101

BRAIN POTENTIALS REFLECT CHANGES IN MEMORY WITH AGE Robert G. Morrison[1,2], Heather D. Lucas[2], Susan M. Florczak[2], Mirinda James[1], Jana M. Wingo[1], Ken A. Paller[2]; [1]Loyola University Chicago, [2]Northwestern University — Memory decline is a fundamental hallmark of cognitive aging, and can be a harbinger for more drastic neurodegenerative changes as in Alzheimer's disease. To characterize these changes and find measures that can predict pathological decline, we developed a continuous recognition paradigm that allows for both behavioral and electrophysiological assessment. Participants viewed a mixed sequence of words and colorful kaleidoscope patterns. Items were shown a second time after 0, 2, 4, or 6 intervening items. Each of the 800 items was endorsed as "new" or "old." Hit rates declined as retention delay increased, and forgetting curves were similar in young (<30 years) and older participants (50-75 years). Yet, event-related potentials (ERPs) were considerably different in the two groups. Younger adults showed late positive old/new effects at all delays. Older adults showed old/new effects that were smaller in amplitude and temporally delayed. Similar late positive ERPs have been associated with explicit-memory retrieval in prior studies. At the longer delays with kaleidoscopes, earlier old/new ERP effects were also evident, and these ERPs resembled ERPs previously associated with perceptual priming. These negative old/new ERPs were greater in older adults than younger adults, suggesting that recognition in certain situations of high difficulty is driven increasingly by implicit memory as people age. Thus, ERPs capable of differentiating implicit and explicit memory may be superior to common behavioral measures of memory not only in providing exquisite temporal information about memory processes, but also in sensitivity to changes in strategies and in memory retrieval abilities in older adults.

A102

BRAIN POTENTIALS INDEX PERCEPTUAL LEARNING AND PERCEPTUAL PRIMING WITH KALEIDOSCOPE IMAGES Ken A. Paller[1], Joel L. Voss[1,2]; [1]Northwestern University, [2]The Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign — When a person views an object repeatedly, activity changes in neural populations involved in perceptual analysis and memory representation. However, it is difficult to map neural responses that are altered by repetition onto memory effects, because memory effects can include both facilitated perceptual analysis (as measured in a priming test) and explicit memory retrieval (as measured in a recognition test). In an effort to disentangle these factors, we studied implicit memory for novel geometric shapes that we previously showed could be recognized either in an explicit way (Voss & Paller, 2009b, Neuroimage) or an implicit way (Voss & Paller, 2009a, Nature Neuroscience). Perceptual priming was indicated by speeded responses to repeated stimuli in a task that required subjects to count the number of colors used in each stimulus. Repetition was associated with negative shifts in brain potentials at ~200-400 ms, and these amplitude differences were largest for the trials with the greatest magnitude of priming. Furthermore, amplitudes of positive potentials indicative of perceptual learning during initial stimulus presentation predicted subsequent priming magnitude. These findings indicate that repetition of novel stimuli produces perceptual fluency with distinctive neural correlates that closely resemble those previously associated with accurate recognition decisions based on guessing, thus substantiating prior demonstrations of implicit recognition (Voss & Paller, 2009a). Additionally, the amount of perceptual learning engaged during the first encounter with a stimulus, as indexed by brain potentials, can be systematically related to how fluently the stimulus is processed upon seeing it for a second time.

A103

TEMPORAL CONSCIOUSNESS AND VARIETIES OF CONFABULATIONS IN ALZHEIMER'S DISEASE AND IN AMNESIA Valentina La Corte[1,2], Mara Serra[4], Marie-Françoise Boissé[3], Gianfranco Dalla Barba[1,2,3,4]; [1]Université Pierre et Marie Curie - Paris VI, Paris, France, [2]Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, INSERM, U975, Paris, France, [3]AP-HP, Hôpital Henri Mondor, Service de Neurologie, Créteil, France, [4]Università degli Studi di Trieste, Italy — Confabulation often consists either of true episodes misplaced in time and place or of personal habits and routines that are considered by the patient as specific personal episodes. When asked what they did today or what they will do tomorrow, confabulators may reply with well established memories, however irrelevant these memories may be to their present situation. The aim of this work was to better characterize and quantify the type of confabulations produced by 10 patients with mild Alzheimer's disease (AD) and 8 confabulating amnesic patients (CA) of different aetiologies. Confabulations were collected with the Confabulation Battery (Dalla Barba, 1993), which comprises 169 questions tapping various aspects of semantic and episodic memory. Overall AD patients confabulated significantly less than CA patients. Both patients groups confabulated significantly more in answering questions tapping episodic memory, than in others types of questions. In both patients groups the majority of confabulations consisted of general memories, habits or misplacements in time and place of true memories. These results are interpreted as reflecting different degrees of Temporal Consciousness (TC), i.e. conscious awareness of one's own past, present and future, dysfunction in AD and CA. According to the Memory, Consciousness and Temporality Theory (Dalla Barba, 2002) the integrity of the medial temporal lobe (MTL) and related structures is crucial for the normal functioning of TC. Confabulators still have TC, which works in an abnormal way. CA patients confabulate more because they have relatively preserved TC and MTL structures compared to AD patients.

A104

DREAMING OF A LEARNING TASK IS ASSOCIATED WITH ENHANCED SLEEP-DEPENDENT MEMORY CONSOLIDATION Erin Wamsley[1], Matthew Tucker[1], Jessica Payne[1,2,3], Joseph Benavides[1], Robert Stickgold[1]; [1]Harvard Medical School/Beth Israel Deaconess Medical Center, [2]Harvard University, [3]Notre Dame University — It is now well established that post-learning sleep is beneficial for human memory. Human and animal studies suggest that this mnemonic benefit may be associated with the neural-level reactivation of memory traces during sleep. Here, we report that improved performance on a virtual navigation memory task several hours after initial training was strongly associated with task-related dream imagery during an intervening afternoon nap. Subjects who napped following training on the spatial memory task (n=50) improved significantly more at retest than those who remained awake during the retention interval (n=49; p=.02). In the Sleep group, the participants who reported task-related dream experiences ranked amongst those with the largest post-sleep performance improvements in the sample (Mann-Whitney rank order test, p=.005), improving tenfold more than Sleep participants without task-related reports (p=.0004). Task-related thoughts during wakefulness, however, were not associated with improved performance. These observations suggest that sleep-dependent memory consolidation in humans is facilitated by the offline reactivation of recently formed memories, and furthermore, that dream experiences reflect this memory processing. That similar effects were not seen during wakefulness suggests that these mnemonic processes are specific to the sleep state.

A105

SLEEP SELECTIVELY BENEFITS MEMORIES RELEVANT FOR THE FUTURE Ines Wilhelm[1], Susanne Diekelmann[1], Ina Molzow[2], Amr Ayoub[1], Jan Born[1]; [1]University of Luebeck, [2]University of Wuerzburg — Sleep consolidates memory, which has been proposed to result from an active and selective reprocessing of newly encoded information. However, neither the selectivity of sleep associated memory consolidation has been compellingly demonstrated nor are the factors known that determine access of a memory to sleep associated consolidation. Here, we show that the mere expectancy that a memory will be used at a future test distinctly enhances the benefit for this memory from post-learning sleep. Subjects learned to criterion declarative memories before retention periods of sleep and wakefulness. There was a strong sleep-dependent improvement at delayed retrieval if subjects were informed about this retrieval test after the learning period. If they were not informed, retrieval after retention sleep was not better than after wake retention intervals, and retrieval expectancy also did not influence retention across wake intervals. Retrieval expectancy likewise enhanced sleep-dependent consolidation of procedural memory. It increased slow wave activity and sleep spindle counts during post-learning slow wave sleep (SWS). Declarative memory consolidation was highly correlated to slow wave activity and spindle counts ($r > 0.72$), but only in the intention-group. Sleep benefits preferentially the consolidation of memories that are relevant for the future, presumably through SWS-dependent reprocessing of the memories.

A106

ON THE ROLE OF ATTENTIONAL PROCESSES IN EVENT-BASED PROSPECTIVE MEMORY Justin B. Knight[1], Gene Brewer[1], Brett A. Clementz[1], Richard L. Marsh[1]; [1]University of Georgia — Event-based prospective memory (PM) refers to the cognitive processes that enable completion of intentions through reliance on some environmental cue. Among PM theorists there is much debate as to whether preparatory attentional processes are always needed in order to notice intention related cues and fulfill intentions. Using dense-array electroencephalography, we sought to examine this issue by evoking a visual steady-state response (SSVEP; i.e., by presenting a flickering box with a superimposed flickering linguistic stimulus) while participants performed a lexical decision task with a PM intention. Two groups of participants were either given the intention to make a special key press when they saw the word horse (focal intention) or when they saw any animal word (nonfocal intention). In comparisons to neural activity when both groups completed a lexical decision task with no intention, attentional modulation of SSVEPs across ongoing trials was evident in a sustained increase in single trial power over occipital-parietal regions from around 250-1500 ms post-stimulus onset for the nonfocal group. No such attentional modulations were present for the focal group. Considering the focal group detected a higher proportion of cues yet showed no evidence of reliance on preparatory attentional processes as assessed by modulation of SSVEPs and behavioral response times, our results provide evidence that preparatory attentional processes are not always necessary to notice intention related cues and successfully fulfill intentions. These findings provide support for the multiprocess view of PM and challenges for the preparatory attentional and memory processes theory.

A107

DO ORGANIZATIONAL STRATEGIES MEDIATE NONVERBAL MEMORY IMPAIRMENT IN DRUG-NAÏVE PATIENTS WITH OBSESSIVE-COMPULSIVE DISORDER? Na Young Shin[1], Do-Hyung Kang[2], Jung-Seok Choi[2], Myung Hun Jung[2], Joon Hwan Jang[2], Jun Soo Kwon[1,2]; [1]Interdisciplinary Cognitive Science Program, Seoul National University, Seoul, Korea, [2]Brain & Cognitive Sciences-WCU program, College of Natural Sciences, SNU & Seoul National University College of Medicine, Seoul, Korea — Nonverbal memory impairment is one of the most consistently reported neurocognitive findings in obsessive-compulsive disorder (OCD). Recent studies have reported that memory dysfunction is mediated by organizational strategies in patients with OCD. The present study aimed to evaluate nonverbal memory and organizational skill in patients with OCD who had never received psychotropic medication. One hundred twenty-three subjects (41 drug-naïve OCD patients, 41 medicated OCD patients, 41 healthy controls, all matched for gender, age, education, and intelligence) made up three groups. The Rey–Osterrieth Complex Figure Test (RCFT) was administrated to evaluate nonverbal memory ability and organizational strategy. OCD patients demonstrated impaired nonverbal memory irrespective of medication status. Medicated patients showed deficits in organizational strategies, which mediated nonverbal memory impairment. In drug-naïve patients, degree of impairment in organizational skill was not severe enough to achieve statistical significance and the association between organization and nonverbal memory was weak. The present results provide new evidence suggesting that organizational skill might not be a reliable factor in explaining impaired nonverbal memory in a drug-naïve sample of patients with OCD. Our findings also indicate that the clinical characteristics may be important to consider in future research. Further studies are needed to better understand the nature of nonverbal memory dysfunction in OCD.

A108

INTERACTIONS OF MULTIPLE MEMORY SYSTEMS DURING INITIAL AND REVERSAL LEARNING Kathryn C. Dickerson[1], Victoria K. Lee[1], Mauricio R. Delgado[1]; [1]Rutgers University — Learning about the value of a stimulus can occur through multiple learning and memory systems posited to exist in the brain. One can learn that a stimulus predicts reward through trial and error/feedback (basal ganglia dependent). Alternatively, the same association can be formed by mere observation that the stimulus predicts reward (hippocampus dependent). It is unclear however, how such memory systems interact when updating a previously learned reward contingency in a manner that is consistent or inconsistent with initial acquisition. To address this question we scanned participants during a probabilistic learning task where they learned the value of several visual cues (100%, 87.5%, or 62.5% probabilistic) and then updated the information in a reversal session. During initial learning, participants learned the associations of 6 cues via a distinct learning type (feedback for group 1; observation for group 2). During the reversal phase, both groups updated contingencies via feedback (3 cues) and observational (3 cues) learning. Employing this design allowed us to examine how participants' behavior and their underlying neural circuitry were modulated when learning type was consistent or inconsistent with how the information was originally acquired. Preliminary results suggest that both groups were able to learn and reverse contingencies successfully. Activity in the striatum was observed during learning, irrespective of learning type (FB or OB) or learning session (initial or reversal). In contrast, engagement of the hippocampus was only observed during initial observational learning and during reversal for participants who initially learned via observation (group 2).

A109

DOES THE WORD FREQUENCY MIRROR EFFECT STILL EXIST IN HEALTHY OLDER ADULTS AND IN PATIENTS WITH ALZHEIMER'S DISEASE? Eve Attali[1,2], Gianfranco Dalla Barba[1,3]; [1]CRICM INSERM U975, [2]Université Paris 6, [3]Universita degli studi di Trieste — The word frequency mirror effect (WFME) reflects the fact that Low Frequency-words (LF) produce more Hits and less False Alarms (FA) than High Frequency-words (HF). It had been explained by different memory or attentional theories. Because of the cognitive changes that occur in both memory and attention in healthy older adults (OA) and in mild Alzheimer's disease (AD), the WFME pattern may differ in these populations. 35 young adults (YA), 34 OA and 18 mild-AD studied lists of HF- and LF-words, and were given a yes/no episodic recognition memory test. Results indicated: - a group effect with a decrease of Hits and an increase of FA across age and AD. - a word frequency effect: LF-words produce both a higher Hit rate and a lower FA rate than HF-words. - a word frequency X group interaction: the WFME is present in YA, decreases in OA, who recognize HF-words as well as LF-words, and tends to reverse in AD who better recognize HF- than LF-words. The frequency effect in Hits decreases across age and reverses for the mild AD patients, whereas it persists in FA rate. These results can be explained by the fact that OA and AD fail in the attention demanding recollective processes but not in the more automatic familiarity-based processes. Moreover, if we consider that HF-words have a deeper semantic memory representation than LF-words, we can explain the reverse advantage for HF-words in Hits for AD who have an earlier/specific episodic memory deficit but a preserved semantic memory.

A110

PREDICTING MEMORY FORMATION OF SCENES: AN ERP STUDY Julie Yoo[1], Marianna Eddy[1], Nupur Lala[1], John Gabrieli[1,2]; [1]Massachusetts Institute of Technology, [2]McGovern Institute for Brain Research, Massachusetts Institute of Technology — The rate of learning or memory formation varies over time, in part due to moment-to-moment fluctuation of brain state. The aim of the present study was to discover whether there are signals in electroencephalography (EEG) data that might provide predictive information as to what brain state is more conducive to learning and memory acquisition. In order to explore if there are such brain signals, we conducted an event related potentials (ERP) study using a subsequent memory paradigm. Twenty subjects underwent EEG recording with a 32-electrode array while viewing 225 novel scenes singly presented for 2 seconds and preceded by a fixation cross for 2 seconds. A recognition memory test was administered in a second session. A 2-second pre-trial interval was analyzed for each successfully remembered and unsuccessfully remembered scene. The 2-second interval was further broken down into 100 ms increments and a time-course analysis were performed with a 2 (Memory: Remembered/Forgotten) x 3 (Electrode Site: Frontal,/ Frontal Central-Medial/Frontal Central-Lateral) x 2 (Hemisphere: Left/ Right) ANOVA comparing trials that were subsequently remembered and forgotten at electrodes that showed predominant effects. Brain states measured just prior to scene presentation correlated with whether that scene was later remembered or forgotten. There was a stronger negative going deflection for subsequently remembered stimuli than forgotten stimuli approximately 250 ms before stimuli onset. The trial by trial classifications analyses on the ERPs and the spectral profiles of the EEG signals were also performed to build a classifier for using the pre-trial information to enhance memory encoding.

A111

ELECTROPHYSIOLOGICAL INDICES OF THE CONTRIBUTIONS OF LONG-TERM MEMORY TO DECISION-MAKING Carol Baym[1], Neal Cohen[1], Kara Federmeier[1], Brian Gonsalves[1]; [1]University of Illinois at Urbana-Champaign — Many types of everyday decisions are based on both declarative and non-declarative long-term memory for past experience. How and under what conditions long-term memory subserves various types of decisions, however, is currently not well characterized in the psychological or electrophysiological literature. The current study examined how processing during the encoding and retrieval of photographs is related to later decisions regarding the quality of those memory representations, as indexed by event-related potentials (ERPs). Healthy young adults were shown color photographs of easily-nameable common objects and were instructed to remember them for later. At test, participants were cued with the name of a studied object (e.g., "apple") and asked to make a decision regarding the test difficulty they would like for that trial. Probe trials were 2-, 3-, or 4-alternative forced-choice recognition tests and reward for correctly choosing the previously studied exemplar increased linearly with test difficulty. Behaviorally, participants distributed their choices across the three test difficulties and performed with similar accuracy across the three, suggesting that they were able to use some aspect of long-term memory strength to guide behaviorally advantageous decisions. Preliminary ERP results during initial encoding show enhanced positivity for items for which participants later selected the hardest memory test, suggesting that memory signals at encoding indeed provide at least part of the basis for later choice behavior. Additionally, ERP responses to the cue word differed depending on which test participants then selected. Results are discussed in terms of how the quality of memory encoding can affect subsequent decisions.

A112

THE ROLE OF THE STRIATUM IN HABIT LEARNING: EFFECTS OF REPETITION ON LEARNING IN PARKINSON'S DISEASE Nathaniel Clement[1], Karin Foerde[1], Erin Kendall Braun[1], Daphna Shohamy[1]; [1]Columbia University — Studies of the neural bases of learning and memory have suggested that the striatum supports incremental learning of stimulus-response associations. However, less is known about the role of the striatum after learning, when learned knowledge must be accessed to guide behavior. In this study, we sought to advance understanding of the role of the striatum in learning by comparing the performance of patients with disrupted striatal function due to Parkinson's disease against that of matched controls in a two-phase learning and generalization task. The first phase involved feedback-based learning of associations. The second phase involved generalization of what was learned to novel stimulus combinations. Given that the striatum is thought to be sensitive to the repeated experience of stimuli and associated responses, and given a putative competition between habit learning in the striatum and flexible use of learned knowledge (supported by the hippocampus), we hypothesized that in healthy controls repetition would enhance learning but impair generalization. We further predicted that this effect of repetition on learning and generalization would not be found in Parkinson's patients. To test this hypothesis, during learning, associations were repeated either many times (high-repetition condition) or few times (low-repetition condition). We found that more repetition led to reduced generalization in healthy individuals; however, repetition did not modulate generalization in Parkinson's patients. This pattern of results highlights the role of the striatum in mediating the effects of repetition on learning and raises questions about the dynamic relationship between multiple brain systems that contribute to learning.

A113

THE MEDIAL TEMPORAL LOBES ARE INVOLVED IN LATE BUT NOT EARLY ITEM GENERATION IN A CATEGORY FLUENCY TASK Signy Sheldon[1,2], Morris Moscovitch[1,2]; [1]University of Toronto, [2]Rotman Research Institute — Recent studies have suggested that category fluency, a traditional semantic task, involves areas within the medial temporal lobes (MTL; Ryan, et al., 2008). Given that the MTLs are crucial for episodic memory, this suggests that category fluency may involve episodic processes. The aim of the current study was to examine more specifically how the MTLs contribute to category fluency, and more generally, semantic tasks. We propose that the MTLs are involved in semantic tasks after classic semantic processes have been exhausted. Specific to category fluency, we suggest that initial item generation will be based upon well-rehearsed, prototypical knowledge, but as this semantic knowledge is depleted, episodic memory processes become more relevant. To test this, participants were presented with categories that elicited various retrieval types and were asked to generate items that belonged to these particular categories while in an fMRI scanner. Importantly, for categories that could benefit from episodic processes, greater activity in the MTL structures (hippocampus, parahippocampal gyrus) and other associated brain regions (e.g. middle frontal gyrus, precuneus) was found for later generated items compared to earlier generated items. Areas associated with semantic processing (e.g. left inferior frontal gyrus) were more active for earlier generated items compared to later generated items. This study suggests that episodic memory processes contribute to semantic tasks after semantic search strategies have been exhausted or when the semantic task (e.g. thinking of items) becomes more ambiguous.

A114

DISSOCIABLE BRAIN PATTERNS EMERGE WITH THE ACQUISITION OF NEW VISUAL CATEGORIES Amy Palmer[1], Richard Granger[1]; [1]Dartmouth College — Brain responses to object categories, and to the psychophysics of category boundaries, have been much studied; but relatively few experimental investigations have focused on how new categories are learned. Effortless adult recognition of, e.g., animals, birds, and cardinals was necessarily preceded by a time when these nested category structures were acquired. Recent studies have shown that some of these regions change when psychophysical boundaries between arbitrary categories are shifted; in contrast, the present study aims at identifying mechanisms that underlie the acquisition of entirely new prototype-based categories. We studied the emergence of category structure using abstract dot patterns that were distortions of separate central prototypes. Subjects initially performed at chance on these patterns, but after brief (20 min) training exceeded 90% recognition. Full brain searchlight analysis before and after training identified regions in medial and inferior temporal lobes as well as in frontal and basal ganglia regions that corresponded to the acquisition of new category knowledge. The findings suggest a network of brain regions that emerge as new categories are formulated based on visual experience.

Long-Term Memory: Semantic

A115

ELECTROPHYSIOLOGICAL CORRELATES OF METAMEMORY JUDGMENTS: COMPARING RETRIEVAL OF SEMANTIC KNOWLEDGE USING MUSICAL AND VERBAL CUES Maya Zuckerman[1], Daniel A. Levy[2], Roni Tibon[3], Niv Reggev[1], Anat Maril[1]; [1]The Hebrew University of Jerusalem, [2]The Interdisciplinary Center (IDC), [3]Bar-Ilan University — Insights into memory retrieval processes may be obtained by examining metamemory states such as Feelings-of-Knowing (FOKs), the feeling that a currently unrecalled item nevertheless exists in one's long term memory. Neural correlates of metamemory have been studied using both verbal and visual stimuli. Musical stimuli may serve as a special class of retrieval cues, as they provide incrementally increasing amounts of cue information that may lead to a dynamic FOK pattern over time. We conducted an ERP study of retrieval of semantic knowledge using either auditory verbal or musical cues (current N=9). Items of general knowledge were queried with short final-word-critical questions, and names of commonly-known songs were queried using short initial song segments. In a within-subject design, ERPs were measured while participants were presented with verbal and musical cues and required to rate their FOK (Know/ Tip-of-the-Tongue [TOT]/ Feeling-of-Knowing [FOK]/ Don't Know) by key-press. Knowledge claims were confirmed off-line following the recording session. EEG data were analyzed for response-locked epochs. Analysis reveals a TOT-related fronto-central positive peak at ~650 ms before response relative to the other three conditions for the general knowledge retrieval, and a different pattern associated with successful retrieval in both verbal and musically-cued retrieval in frontal electrodes in the 400-600 ms pre-response range, differing in stability between modalities. These patterns of activity may reflect participants' continued FOK-motivated attempts to retrieve information up to response execution. Further, spectral analysis of the EEG data is expected to reveal continuous activation patterns related to different levels of FOK.

A116

POSTER TITLE: NEUROPHYSIOLOGICAL EVIDENCE THAT REPETITION EFFECTS AND THEIR PERCEPTUAL-SPECIFICITY DIFFER BETWEEN CATEGORY AND RECOGNITION DECISIONS WITH VISUAL OBJECTS Stephen Maher[1], Haline Schendan[1]; [1]Tufts University — Two event-related potential experiments compared repetition effects during category and recognition decisions and assessed whether these varied with exemplar changes between study and test and exemplar typicality. The two-state interactive account of visual object cognition predicted greater effects on a centrofrontal N390 during categorization, and memory theories predicted the late positive complex (LPC) index of episodic explicit memory would be greater on recognition. Repetition effects were exemplar-specific on the centrofrontal N390 but not the centroparietal N400 index of linguistic semantic integration. Both N390 and N400 repetition effects were greater during category than recognition decisions, indicating these effects index implicit memory for visual object and linguistic knowledge, respectively. In addition, a parietal P600 showed exemplar-specific repetition effects during both category and recognition decisions. As predicted, the LPC was larger during recognition than category decisions. Together with prior evidence, N390 findings indicate that visual object knowledge in occipitotemporal cortex supporting model selection is visually-specific for the particular view and exemplar of an object but not local contours composing these global shapes, and this knowledge is selectively involved in category decisions and implicit memory. In contrast, later memory during the P600 is highly visually-specific for the line contours in a particular view of an object exemplar during category and recognition decisions, and the LPC reflects strategic recollection from episodic explicit memory that is more strongly recruited for recognition decisions. Overall, memory reactivation can depend upon decision demands.

A117

EEG CORRELATES OF OBJECT RECOGNITION DURING AN ONGOING VISUAL PERCEPTION TASK Roman Freunberger[1,2], Robert Fellinger[1], Markus Werkle-Bergner[2], Wolfgang Klimesch[1]; [1]University of Salzburg, Austria, [2]Max-Planck Institute for Human Development, Germany — Most EEG studies rely on event-related task designs to investigate neural correlates of object recognition. By averaging over many trials, this procedure allows the extraction of evoked and clearly phase-locked neural signatures related to stimulus processing. Towards a more natural setting for object recognition we used short ongoing video-sequences where no specific "event" could occur. The videos initially started with blurred images of an object (real or distorted) that became clearly visible later during the sequence. The participant's task was to indicate when they recognized the object. We also included a purely sensory control condition where subjects distinguished between mirrored and not-mirrored objects. We replicated initial findings from a previous event-related study (Freunberger et al., 2008, Neuroimage) showing that the time point of object recognition is related to an amplitude decrease and a stronger phase-coupling between frontal and posterior electrode sites within the human alpha rhythm (~12Hz). The alpha-specific effects were not observed for the sensory task supporting the assumption that alpha is especially relevant for semantic and not sensory processing. Furthermore, the ongoing task-design allows to infer that the alpha effects are not simply caused by evoked brain responses due to stimulus-presentation. We conclude that modulations of ongoing alpha-oscillations reflect a guiding mechanism that enables the access to a (semantic) long-term memory trace.

A118

A LINK BETWEEN FAMILIARITY IMPAIRMENTS IN RECOGNITION MEMORY AND IMPAIRMENTS IN FAMILIARITY ASSESSMENT FOR SEMANTIC CONCEPTS ACQUIRED OVER A LIFETIME Ben Bowles[1], Ken McRae[1], Stefan Köhler[1]; [1]University of Western Ontario — Recognition memory is supported by two processes, recollection and familiarity. Recollection provides recovery of contextual detail of a prior encounter, while familiarity signals prior occurrence without such recall. Previously, we demonstrated that patient NB, who underwent resection of the left anterior temporal lobe with hippocampal sparing, exhibits impairments in familiarity with preserved recollection. Here, we examined whether NB also exhibits impairments in a task that requires assessment of familiarity based on lifetime exposure and, unlike a recognition memory test, does not make reference to a specific study episode. NB and 22 controls rated their familiarity for 541 concepts, such as plates and chipmunks. To establish reliability, we recruited NB and five control participants on a second occasion several months later. On both occasions, NB differed from controls in that the correlation between her familiarity ratings and those of the average control was lower than that of any other participant. Furthermore, NB's test-retest correlation was the lowest. In addition, NB's familiarity ratings differed from control participants' ratings in how they were related to the presence of specific feature types across all items. For example, NB's familiarity ratings correlated to a significantly greater degree than did controls' with the number of encyclopedic features listed for the concepts, and to a significantly lesser degree with the number of visual form and surface features. These results are consistent with the idea that a common process supports familiarity assessment in both recognition memory and in tasks that depend on semantic representations acquired over the lifetime.

A119

PROFESSIONAL MUSICIANS EXHIBIT EXPERIENCE-DEPENDENT NEUROPLASTICITY OF SEMANTIC MAPS FOR MUSICAL INSTRUMENTS IN AUDITORY CORTEX Klaus Hoenig[1], Cornelia Müller[1], Bärbel Herrnberger[1], Eun-Jin Sim[1], Manfred Spitzer[1], Günter Ehret[1], Markus Kiefer[1]; [1]University of Ulm, Germany — The brain of professional musicians constitutes an ideal model for understanding experience-dependent neuroplasticity, particularly in the auditory and motor domain. The intensive sensorimotor experience of musicians with musical instruments has been shown to entail plastic brain alterations in cortical perceptual and motor maps. However, it is hitherto unknown whether learning-dependent plasticity in the brain of musicians extends beyond basic perceptual and motor representations to higher-level conceptualizations of the world. Using a picture-word matching paradigm and a sound perception task during fMRI scanning, we show that visual recognition of musical instruments automatically activates right posterior superior and middle temporal gyri (pSTG/MTG) only in professional musicians, but not in musical laypersons. These areas in auditory association cortex were recruited both by conceptual processing of musical instruments during visual object recognition, and auditory perception of real sounds. Hence, the unique intensive experience of musicians with musical instruments translates into a reorganization of conceptual knowledge in the human brain, i.e., the very building blocks of human cognition. This evidence unequivocally demonstrates that experience-driven neuroplasticity in professional musicians is not confined to the alteration of perceptual and motor maps, but even affects the higher-level functional reorganization of semantic maps embodied in auditory cortex. These findings do not only highlight the eminent importance of sensory and motor experience for acquiring rich concepts of the world, they are also a starting point for a deeper understanding of how the brain allows music to speak to all aspects of the human being.

A120

INVOLVEMENT OF SEMANTIC MEMORY IN THE DEFAULT MODE NETWORK Wirth Miranka[1], Jann Kay[1], Dierks Thomas[1], Federspiel Andrea[1], Wiest Roland[1], Horn Helge[1]; [1]University Hospital of Psychiatry, Bern, Switzerland — The Default Mode Network (DMN) is a higher-order resting state network associated with internally-generated self-referential thought. As such, the DMN is thought to incorporate basic cognitive modules which contribute to internal mentation. In the effort to deduce these functional sub-units, episodic memory was recently associated with the DMN. Likewise, it has been suggested that semantic memory is involved in the DMN; however, evidence for anatomical and functional convergence of the DMN and semantic memory is missing. Using state-of-the-art Independent Component Analysis (ICA) and a well-established block-design fMRI paradigm, we examined spatial and functional links regarding the DMN and fMRI-correlates evoked by a semantic memory task in comparison phonological and perceptual decisions to visually-presented words. Our findings show selective spatial overlap between the DMN and semantic activations within left-hemispheric hetero-modal brain regions, that is, lateral parietal, temporal, medial frontal, inferior frontal and posterior cingulate areas. Correspondingly, semantic retrieval induced less deactivation within the global DMN and these local overlapping regions compared to phonological and perceptual processing. Our results indicate that semantic memory constitutes an integral part of default cognitions involving high-order association cortices. These brain regions are thus proposed to constitute associative hubs likewise recruited during internally- and externally-generated semantic operations. Overall, our findings substantiate views that the default cognitive mode as mediated by the DMN incorporates memory systems.

A121

THE ROLE OF THE ANTERIOR TEMPORAL LOBES IN THE PROCESSING OF PERSON-SPECIFIC SEMANTIC INFORMATION Simona Maria Brambati[1,2], Sophie Benoit[1], Laura Monetta[3], Sylvie Belleville[1,2,4], Sven Joubert[1,2,4]; [1]Centre de recherche de l'Institut Universitaire de Gériatrie de Montréal, QC, Canada, [2]Unité de Neuroimagerie Fonctionnelle, CRIUGM, QC, Canada, [3]Centre de recherche Université Laval Robert-Giffard, Québec, QC, Canada, [4]Université de Montréal, QC, Canada — Neuroimaging studies on healthy subjects have reported the involvement of the anterior temporal lobes (ATL) in recognizing known people. However, it is still matter of debate whether this activation is associated with the name retrieval or the access to person-specific semantic information. To address this issue, we used fMRI to map the brain regions involved in the semantic processing of famous faces at a general and specific level. Specifically, participants (n=12, mean age =23.0 ± 1.7 years, F/M = 8/4) were asked to determine whether the stimulus photograph matched with the label of the occupation category (such as politics, show business, sport in the general condition, mayor, singer, director in the specific condition). All famous face stimuli were presented in both general and specific conditions. Image pre-processing and random effects statistical analyses were performed using standard methods implemented in SPM8. Semantic processing of famous faces in both general and specific conditions revealed a common network of activation involving the occipital cortex, the fusiform gyrus and the inferior frontal gyrus (pars triangularis) bilaterally, and the ATL, parahippocampal and posterior middle temporal gyri in the right hemisphere. Specific relative to general categorization activated left ATL and the posterior middle temporal gyrus. Moreover, increased activation in the left ATL in the specific categorization condition was associated with increase in effective connectivity from the right ATL, as revealed by Dynamic Causal Modeling analysis. These findings support the idea of a crucial role of the anterior temporal lobes in the processing of person-specific semantic information.

A122

A CONCURRENT MANUAL TASK INTERFERES WITH THE NAMING OF OBJECTS THAT ARE FREQUENTLY MANIPULATED Eiling Yee[1], Evangelia G. Chrysikou[1], Cindy Navarro[1], Mariam Akbar[2], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania, [2]Brandeis University — Sensorimotor-based theories of semantic memory claim that semantic information about an object is distributed over the neural substrates that are invoked when we perceive and interact with that object. This predicts that occupying a neural substrate that is an important part of an object's representation (e.g., with a concurrent secondary task) should interfere with the ability to access that representation. We tested this prediction as it pertains to the manipulation component of an object's representation by requiring participants to name pictures of objects under conditions of "interference" (performing a concurrent manual task) or "no interference" (no concurrent task). Objects varied (according to ratings from separate subjects) in the extent to which one interacts with them manually (e.g., tiger = low manual interaction, hammer = high manual interaction). Preliminary results show that performing a concurrent manual task increases naming errors for all objects. Critically, however, the increase in errors is greatest for objects rated as high in manual interaction. This interference effect suggests that the conceptual representations of these frequently manipulated objects share resources (specifically, motor resources) with those that are required to perform an overt manual task. Further, it suggests that motor information about these objects is accessed even when the primary task (lexical access for picture naming) does not manifestly require it.

A123

ACOUSTIC AND ACTION-RELATED CONCEPTUAL FEATURES RAPIDLY ACTIVATE THE AUDITORY AND MOTOR BRAIN SYSTEMS Natalie Trumpp[1], Klaus Hoenig[1], Eun-Jin Sim[1], Friedemann Pulvermueller[2], Markus Kiefer[1]; [1]University of Ulm, Germany, [2]MRC Brain and Cognition Unit, Cambridge, UK — The organization of the conceptual system is controversially debated. Classical models assume that conceptual knowledge is abstract and represented in an amodal unitary system distinct from sensory and motor systems. More recent models, however, propose that concepts are embodied in the sense that interactions with objects form their conceptual memory traces in distributed modality-specific brain areas, which typically process sensory or action-related object information. In support of modality-specific models, previous neuropsychological studies showed that categorisation tasks with, for example, natural and artificial concepts evoke differential activation in sensory and motor brain regions. Here we investigated the neural representation of acoustic and action-related conceptual features using ERPs. Participants performed a lexical decision task on visually presented object names which referred to objects with high relevance of acoustic ("helicopter") and action-related ("hammer") conceptual features, respectively, as well as pseudowords as distracters. Feature dependent ERP effects were observed 100-132 ms after stimulus onset over the frontal and central scalp. Source analyses revealed that words with acoustic conceptual features elicited stronger activities in superior temporal brain regions that belong to the auditory association cortex. Words with action-related features, however, showed stronger activity in central brain regions close to the motor cortex. As these effects emerged very early after word onset, they reflect rapid access to acoustic and action-related conceptual features rather than post-conceptual processing. In line with modality-specific models, our results support the assumption that concepts are embodied in the sensory and motor systems of the human brain.

A124

WHAT PART OF THE TEMPORAL LOBE IS CRITICAL FOR PICTURE NAMING? DIVERGENCE OF ACTIVATION STUDIES AND DEMENTIA LESION STUDIES Howard Chertkow[1,2], Jim Nikelski[1], Haythum Tayeb[1,2], Alan Evans[2]; [1]Lady Davis Institute, Jewish General Hospital, McGill University, [2]McGill University — Semantic memory and access to phonological representations are critical stages in naming pictures, and both clearly involve activity in the left temporal lobe (LTL) in most individuals. We report of series of studies pointing to a divergence in the localization of naming in the LTL depending on whether data is derived from activation studies in normal individuals, or associated with brain damage. In a series of activation studies in normal young and old subjects using fMRI and oxygen 15 PET, picture naming for pictures of decreasing was most associated (in regression analysis and in subtraction analysis) with activation in posterior left temporal regions. In VBM work with semantic dementia, Grossman and colleagues have demonstrated association with inferior and anterior temporal lobe. In separate work from our laboratory, correlation of anomia with cortical thinning in a large set of Alzheimer's Disease subjects (n = 180) in the ADNI (Alzheimer's Disease Neuroimaging Initiative) study, similarly demonstrated largely anteriornr LTL localization which correlated with degree of anomia. Thus a distinction between posterior sites most associated with activation in normal individuals, and anterior temporal correlations with anomia in various forms of dementia, appears to be the rule rather than the exception. Various hypotheses will be put forward to explain this discrepancy, including technical features of activation studies, and compensatory mechanisms after brain damage.

A125

DISTINGUISHING BETWEEN MEMORY SYSTEMS: FALSE MEMORIES DEPEND ON SERIAL POSITION Halle R. Zucker[1], Kristin E. Flegal[1], Alexandra Atkins[2], Patricia A. Reuter-Lorenz[1]; [1]The University of Michigan, [2]Duke University — The idea that memory can be divided into separable systems dates back at least to William James (1890). Of the various divisions proposed since then, the longest-standing distinguishes short- from long- term memory (STM; LTM). Recent challenges to this dichotomy, favoring a unitary memory system, have come in part from neuroimaging evidence for common regions of activation for STM and LTM tasks. However when imaging across the serial position curve, Talmi and colleagues (2006) found the recency and primacy portions resulted in dissociable activation sites, consistent with separable memory systems. Building on this and other prior findings, we sought to investigate further whether items from the recency and primacy portions of 12-item lists would be subject to different types of memory errors—indicating the operation of different principles. Because we were especially interested in determining the relative susceptibility of LTM and STM to semantic distortions, we used 12 item (supra)lists comprised of 3 sublists following the variant of the Deese-Roediger-McDermott task developed previously in our lab (Atkins and Reuter-Lorenz, 2008). Each sublist contained four strong associates of a common theme word that was always unique to that sublist. Free recall after each supralist indicated poorer veridical memory and more false semantic memories for the primacy sublist, and better recall and more false phonological memories for the recency sublist. A follow-up recognition test indicated superior memory for primacy sublists. These findings support separable memory processes by converging with much prior research demonstrating that different principles operate on memory for different serial positions.

A126

DOES REPEATED PRESENTATION OF ITEMS IN VARYING CONTEXTS LEAD TO SEMANTIC KNOWLEDGE? Stefanie Nickels[1], Bertram Opitz[1]; [1]Experimental Neuropsychology Unit, Saarland University, Saarbrücken, Germany — Memory enhancement after repeated presentation of items is an often replicated finding in memory research. Assumingly this is due to the extraction of shared features of the repeated items, which in sum will be encoded as decontextualized, i.e. semantic knowledge. To investigate this issue, subjects studied celebrity faces along with faces of non famous individuals. Half of the unknown faces were presented either in the same context (background and biographical information) or with varying contexts across presentations. The electrophysiological correlates of explicit memory and conceptual priming for these faces were examined. In the explicit memory condition, the early frontal old/new-effect, an indicator of familiarity, and the late parietal old/new-effect, indexing recollection, were found both for celebrity faces and non famous faces from the different contexts condition. Non famous faces with no variation of context only elicited the partial old/new-effect. Furthermore, conceptual priming in the implicit memory condition was indexed by positive potentials over fronto-central regions, in addition to faster reaction times for previously presented faces. ERP potentials elicited by celebrity faces and non famous faces repeated in different contexts exhibited remarkable similarities. This we interpret as evidence for acquisition of semantic knowledge as a result of repeated presentation of information in varying contexts. Furthermore, results from Frequency Analysis and Independent Component Analysis will be reported.

A127

NEURAL REPRESENTATIONS OF NEW OBJECTS ARE MODULATED BY OBJECT-RELATED SENSORY EXPERIENCE Christian Bellebaum[1,2], Marco Tettamanti[1], Pasquale Della Rosa[1], Irene Daum[2], Stefano Cappa[1]; [1]San Raffaele Scientific Institute and Vita-Salute San Raffaele University, Milano, Italy, [2]Ruhr-University Bochum, Germany — Category-specific impairments of semantic memory observed in neurological patients have given rise to different theories on semantic memory organization. One of the most influential accounts stresses the role of object-related sensory experience, claiming that visual features are more frequently used in the acquisition of knowledge about living objects, and manipulation knowledge plays a larger role for non-living objects. The present study aimed to find direct evidence for this modality-specific theory by inducing new semantic memory representations in healthy subjects. Sixteen volunteers engaged in three training sessions to learn about features of new, manipulable objects. Importantly, the modality of knowledge acquisition was varied: Subjects learned to manipulate one set of new objects, whereas training was restricted to visual features for a second set. A third set of objects was not part of the training. Brain activity was measured with functional magnetic resonance imaging during an object-matching task pre- and post training. Activation increases post- compared to pre-training were observed in the bilateral precuneus irrespective of training. For both visual and manipulation training, increased activity was also found in the left lateral parietal cortex. Specific activation changes for the type of training were found in the left middle temporal gyrus for visual training and in the bilateral middle frontal gyrus for manipulation training. The results show that the neural representation of objects depends on object-related sensory experience and therefore provide support for the modality-specific account of semantic memory organization.

A128

ARE SEMANTIC DEFICITS MODULATED BY THE PRESENCE OF DEPRESSIVE SYMPTOMS IN OLDER ADULTS WITH AMNESTIC MILD COGNITIVE IMPAIRMENT? Julie Brunet[1,2], Carol Hudon[3,4], Joël Macoir[3,4], Sylvie Belleville[1,2], Sven Joubert[1,2]; [1]Centre de recherche, Institut Universitaire de Gériatrie de Montréal, Montréal, [2]Université de Montréal, Montréal, [3]Centre de recherche Université Laval Robert-Giffard, Québec, [4]Université Laval, Québec — Recent evidence suggests that amnestic MCI (aMCI) patients show semantic memory deficits. Studies have also shown that aMCI patients who present with depressive symptoms present with different patterns of episodic memory and executive function deficits when compared to aMCI patients without depressive symptoms, suggesting a role of depression in the presentation of cognitive symptoms. The aim of this study was to examine whether semantic memory deficits in aMCI are modulated by the presence of concomitant depressive symptoms in these persons. Three groups of participants were included in this study: 1) an aMCI group without depressive symptoms (aMCI) (N=17), 2) an aMCI group with depressive symptoms (aMCI-D) (N=15), and 3) a control group (N=36). Participants carried out a semantic test of famous people knowledge, in which they were asked to answer questions testing biographical knowledge about famous political figures, singers, actors, and athletes. Results show that aMCI and aMCI-D patients were significantly impaired compared to the age- and education-matched control group on the semantic test. However, the aMCI-D group and the aMCI group did not differ significantly between each other on the semantic test. These results confirm the presence of semantic deficits in aMCI and aMCI-D, but they indicate that depressive symptoms do not appear to modulate the severity of the semantic deficits in aMCI, at least regarding famous people knowledge. Further studies are needed to explore the relations that exist between depression and memory in individuals at risk of developing Alzheimer's disease. Keywords : semantic memory, MCI, depression

A129

DISRUPTION OF VENTROLATERAL PREFRONTAL CORTEX DURING MEMORY-GUIDED DECISION-MAKING Elizabeth Race[1], Jessica Wilson[2], Benjamin Levy[2], Anthony Wagner[2]; [1]Boston University, [2]Stanford University — Priming-related neural activity reductions have been widely observed in left ventrolateral prefrontal cortex (VLPFC), including mid-VLPFC (BA 45). Recent fMRI evidence (Race et al., 2009) indicates that priming-related activity reductions in mid-VLPFC reflect reduced cognitive control demands when retrieved stimulus-decision associations inform current decision-making. In contrast, stimulus specific and stimulus-response learning reduced processing demands in more rostral and caudal regions of PFC, respectively. While these results demonstrate that left mid-VLPFC control processes operate at the decision level, it is unclear whether left mid-VLPFC computations are necessary when retrieved stimulus-response associations can guide goal-directed behavior. The present experiment used transcranial magnetic stimulation (TMS) to test whether mid-VLPFC processes are necessary for goal-directed behavior in the absence of decision-level learning, regardless of learning at other levels of representation. Subjects performed six blocks of the same semantic classification priming task used by Race et al. (2009) to dissociate learning at the stimulus, decision, and response levels. On three blocks, subjects received TMS (1Hz, 6min) targeting left mid-VLPFC, with TMS applied after completion of the study trials but before the critical test trials. Two main findings are of note: (1) TMS disrupted behavioral performance only when both learned stimulus-decision and stimulus-response associations conflicted with current goals, and (2) TMS did not disrupt priming when accurate responding could be guided by learned stimulus-response associations, regardless of demands on decision-level control. Together, these results demonstrate that mid-VLPFC processing is necessary in the absence of decision-level learning only when learned stimulus-response associations cannot guide goal-relevant behavior.

A130

SEEING THE WOOD FOR THE TREES: ERPS REVEAL ABNORMAL PATTERNS OF PERCEPTUAL AND SEMANTIC PRIMING DURING OBJECT RECOGNITION IN SCHIZOPHRENIA Gina Kuperberg[1,2], Kana Okano[1], Marissa Lipton[1], Marianna Eddy[3]; [1]Tufts University, [2]Martinos Center for Biomedical Imaging, Mass General Hospital, [3]Massachusetts Institute of Technology — We used event-related potentials (ERPs) to probe the time-course of automatic object recognition in schizophrenia. Schizophrenia patients and demographically-matched controls performed a go-no-go semantic categorization task while viewing pictures preceded by masked identical or non-identical picture primes. Two different prime durations, 90ms and 150ms, were used while the SOA was held constant (170ms). Patients showed abnormal patterns of priming on ERP components indexing both early perceptual stages of object recognition (the N/P190) and later semantic processing (the N400). On the N/P190, repetition priming effects were smaller overall in patients than controls, consistent with previous findings indicating impaired perceptual visual processing in schizophrenia. However, like controls, patients were able to take advantage of the longer prime duration to produce larger N/P190 priming effects. The opposite pattern of findings across the two prime durations was seen on the N400: at the short prime duration, patients showed a normal priming effect, suggesting that, under these highly automatic conditions, feedforward activation from the prime effectively facilitated semantic processing of the target picture. At the longer prime duration, however, controls showed a larger N400 effect than at the shorter duration, but patients showed a smaller N400 effect. We suggest that, in controls, efficient mapping of perceptual information to the semantic representation of the prime further facilitated semantic processing of the target, but that, in patients, inefficient early perceptual processing of the prime impeded activation of its semantic representation.

A131

ADVANTAGE EFFECT SWITCHES IN DIFFERENT LEVELS DURING HUMAN INFORMATION RETRIEVAL Haiyan Zhou[1], Wei Jing[1], Jieyu Liu[1], Yulin Qin[1,2], Shengfu Lv[1], Ning Zhong[1,3]; [1]International WIC Institute, Beijing University of Technology, Beijing, China, [2]Carnegie Mellon University, PA, [3]Maebashi Institute of Technology, Maebashi-City, Japan — The effect of basic-level advantage showed some information appeared to be more readily accessible to the human mind (Rogers, 2006, 2007; Rosch, 1976; Wisiniewski, 1989). Other researchers found that the basic-level advantage was not reliable (Large, 2004; VanRullen, 2001). We carried out 3 experiments to investigate how advantage effect switched in different levels in Chinese. A word-picture category matching task and a picture-word category matching task were used in experiment1 and experiment2 individually, with same materials. The results showed that in the word-picture matching task, the basic-level advantage disappeared, inconsistent with Rogers (2007). The inconsistent results might be related to the limited materials. In the picture-word matching task, we found a reliable basic-level advantage. The different advantage effects in experiment 1 and 2 suggested that when the processing relied more on semantic memory, such as in the task of picture-word matching, the basic-level advantage appeared (Pansky, 2006). To further investigate the advantage effect switching, we expanded our materials and used a naming task, which was more natural in experiment3. The results showed except for the very familiar concepts, there was a significant basic-level advantage effect. Based on the results, we concluded that during information retrieval, the advantage effect switching in different levels were constrained by both the semantic representation in memory system and the demand of the outside world.

Attention: Auditory

B1

INDEPENDENT EFFECTS OF SEROTONIN AND DOPAMINE POLYMORPHISMS ON PROCESSING OF ATTENDED AND UNATTENDED AUDITORY INFORMATION IN AN EVENT-RELATED POTENTIAL PARADIGM Theodore Bell[1], Courtney Stevens[2], Helen Neville[1]; [1]University of Oregon, [2]Willamette University — Polymorphisms in both 5HTT (serotonin transporter gene) and DAT1 (dopamine transporter gene) have previously been associated with variability in cognitive performance. In a group of 3- 5-year-old children, we observed differential effects of these polymorphisms on event related potentials to attended and unattended stimuli using a dichotic listening task (described in Sanders, Stevens, Coch, & Neville, 2006). Previous work using this paradigm has shown that distracter suppression to be differentiable from signal enhancement (Stevens, Fanning, Coch, Sanders, & Neville, 2008; Stevens, Lauinger, & Neville, 2009). The long allele of 5HTT was associated with poorer signal enhancement in the attended channel relative to the short allele. In contrast, the 10r allele of DAT1 was associated with poorer distracter suppression in the unattended channel relative to the 9r allele of DAT1. These effects appear to be additive and independent. These results have important implications for theories and models of attention, as well as for our understanding of the impact of genetic variation on cognition.

B2

MUSICAL METER DIRECTS THE HIERARCHICAL ALLOCATION OF ATTENTION IN TIME Ahren Fitzroy[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst — When perceptual systems are overwhelmed by information changing rapidly, listeners can use temporally selective attention to preferentially process the most critical information. Event-related brain potential (ERP) research has shown that temporally selective attention affects early perceptual processing as indexed by the amplitude of the first negative peak 100 ms after sound onset (N1) in a manner similar to that observed for auditory spatially selective attention. Further, the difference in ERPs elicited by sounds at attended and unattended times is larger when the attended time is cued by an isochronous pulse rather than explicit instruction alone. These findings are consistent with entrainment models of dynamic attending that propose attentional resources fluctuate, phase-locked to external rhythms. Entrainment models also predict that hierarchically organized exogenous rhythms will induce a hierarchical distribution of attention across time; the current study employed the hierarchical rhythmic structure found in Western music to test this hypothesis. Auditory evoked potentials elicited by physically identical stimuli presented at times of relative strength and weakness in the metric hierarchies of short melodies were compared in musicians and musically naïve individuals. Sounds presented at points of metric strength elicited larger amplitude N1s than the same sounds presented at points of metric weakness. This result suggests that multiple exogenous periodicities induce a hierarchical allocation of temporally selective attention without explicit instruction and provides electrophysiological support for entrainment models of dynamic attending.

B3

ENTRAINMENT OF OSCILLATORY ACTIVITY TO RHYTHMIC STIMULUS STREAMS IN DEVELOPMENTAL DYSLEXIA Fruzsina Soltesz[1], Denes Szucs[1], Victoria Cheah[1], Usha Goswami[1]; [1]Centre for Neuroscience and Education, University of Cambridge — Introduction: Children with developmental dyslexia have difficulties in auditory rhythmic processing and in rhythmic entrainment. (Goswami et al., 2002; Thomson and Goswami, 2008). Previous studies with monkeys have shown that neuronal oscillations entrain (phase-lock) to the structure of an attended rhythmic stimulus stream (Lakatos et al., 2008). Here we studied an analogous phenomenon in dyslexia. Methods: Adults with DD and control subjects listened to a rhythmic auditory stream of 500Hz sounds presented via earplugs (SOA: 660ms). Occasional oddball stimuli (15%, white noise) required an active response. Deviants served to maintain participants' attention to the stimulus stream. EEG data was collected with a 128-channel Electrical Geodesics system. Event-related spectral perturbation (ERSP) and inter-trial phase coherence (ITC) data in the range of 0.1 to 40 Hz was analysed. Results: A strong expectancy-related power increase was found in control participants prior to the stimuli, across the whole frequency range in ERSP. This expectancy effect was attenuated in the dyslexic group. ITC data reflected event-related potentials in both groups. Conclusions: Our results show that adults with DD show weaker expectancy effects, locked to rhythmic acoustic stimuli, than controls. The lack of a strong oscillatory entrainment in DD may explain their weaker performance in auditory processing tasks, and may play a key role in phonological development via syllabic parsing and representation.

B4

STEPWISE PROCESSING OF NEGATIVE EMOTIONS REVEALED BY FMRI Patricia Bestelmeyer[1], Pierre Maurage[2], Julien Rouger[3], Ian Charest[1], Frances Crabbe[1], Pascal Belin[1]; [1]CCNi, University of Glasgow, [2]Catholic University of Louvain, [3]University of Maastricht — Behavioural adaptation effects for vocal, non-linguistic affective information have recently been shown (Bestelmeyer et al., submitted). Using adaptation (continuous carry-over design) we were interested in the processing stages of vocal affect perception and the neural correlates involved. Nineteen healthy participants took part in this fMRI study. We created four morph continua between anger and fear in seven morph steps of 15% (5/95% anger/fear to 95/5% anger/fear). We employed a continuous carry over design with type-1-index-1 sequence of serially balanced stimuli. Participants listened to these sounds while performing a two-alternative forced choice emotion classification task in a Trim Trio Siemens scanner. Parametric modulation analyses were conducted using SPM8. Two main regressors of interest were identified: first, a physical difference regressor (difference between morph steps of two consecutive stimuli) and, second, a perceptual difference regressor (difference between the mean behavioural responses of each participant for two consecutive stimuli).

We observe a positive correlation between increasing physical difference and BOLD signal in the right amygdala and posterior cingulate as well as bilateral temporal voice areas. After regressing out the effect of physical difference we show a positive correlation between perceptual difference and BOLD signal in the bilateral insulae and left inferior frontal gyrus. Results suggest that the processing of vocal affect recognition happens hierarchically involving the right amygdala, posterior cingulate and bilateral voice areas which are sensitive to physical properties while more abstract, perceptually correlated representations (effect of perceptual difference) of vocal affect are processed in bilateral insulae and left inferior frontal gyrus.

B5

THE N100 RESPONSE TO UNATTENDED STIMULI RELATES TO ADOLESCENT EXECUTIVE FUNCTION WITHIN A NORMALLY DEVELOPING POPULATION Christine Lackner[1], Diane L. Santesso[1], Jane Dywan[1], Terrance J. Wade[1], Sidney J. Segalowitz[1]; [1]Brock University — The N100 auditory ERP component is usually larger to attended compared with unattended stimuli. However, in atypically developing or at-risk populations such differences are not observed and this lack of differentiation has been associated with negative outcomes in school and social situations. In this study, we investigated the N100 response within a typically developing population of adolescents to determine whether individual differences in N100 amplitudes and in executive functioning would be related to each other. Forty 12- to 15-year-olds were administered intermixed and non-overlapping auditory tones to each ear with instructions to respond to targets in one ear only, switching attended ears across blocks of trials. Parents completed the Behavior Rating Inventory of Executive Function (BRIEF). Regression analyses showed that smaller N100s at Fz and FCz to unattended stimuli, adjusted for responses to attended stimuli, were associated with greater global executive scores, whereas the amplitude of the N100 to attended stimuli did not relate to any measures of executive control. Further analyses showed that this N100 effect was associated with the BRIEF index of metacognitive function and not with the index of behavior regulation suggesting a conceptual basis for the relation. These results indicate that the ability to disattend to irrelevant information, as indexed by the N100 to nonattended stimuli, is highly predictive of behavioural indices of executive function.

B6

THE EFFECTS OF ATTENTION ON THE SPEECH PERCEPTION OF INFANTS Karen Garrido-Nag[1,2], Valerie Shafer[2], Richard Schwartz[2], Winifred Strange[2]; [1]Gallaudet University, [2]The Graduate Center, CUNY — Knowledge of how infants use their attentional resources in speech perception will help to understand the nature of language development. Furthermore, knowledge of how attention affects speech discrimination in typically developing infants can be used to examine clinical populations who are known to have both deficits in attention and language (e.g., children with autism). This study examines how attention affects the speech perception skills of 4-to 8-month old infants. More specifically, we explore what role attention plays in the development of vowel perception skills in infants through the use of associative learning between auditory and visual stimuli and explore the functional nature of the brain discrimination responses in infants. This study uses brain discrimination measures (Mismatch Responses ([MMRs]), to compare auditory discrimination of tones and CVC words in two different tasks designed to focus attention differently. Attention is manipulated in tasks by pairing a sound change with a following face (cross-modal) task consistently or inconsistently. This leads to an associative relation being built between the auditory and visual stimuli. Cross-modal processing can facilitate the discrimination of sound contrasts by directing attention to one modality by using the other modality as a reward. Results have shown that negative Mismatch Responses (MMRs) were present when attention was focused to the change in the sound. A significant difference was seen in the amplitude of the MMR when focusing attention on the sound change versus attending to the overall auditory stimuli. Directed attention may be required for infants to actively discriminate difficult contrasts.

B7

ELECTROPHYSIOLOGICAL INDICES OF LANGUAGE PROCESSING IN VEGETATIVE STATE (VS) AND MINIMALLY CONSCIOUS STATE (MCS) – PREVALENCE AND PROGNOSTIC VALUE Inga Steppacher[1], Simon Eickhoff[1], Michael Kaps[2], Wolfgang Witzke[2], Johanna Kissler[1]; [1]University of Konstanz, [2]Kliniken Schmieder Allensbach — This study investigated whether patients with severe disorders of consciousness after brain injury show electrophysiological signs of language processing and if so, whether their presence is associated with a favourable clinical outcome. The N400 Event Related Potential (ERP) in response to semantically congruous and incongruous sentence endings was recorded in 175 patients with severe disorders of consciousness (vegetative state ~ VS or minimally conscious state ~ MCS). The presence of a N400 was evaluated by interrater reliability among three experts and using a single trial ERP quantification method, the t-continuous wavelet transform (tCWT, Bostanov & Kotchoubey, 2006). Clinical follow-ups were available for 92 out of the 175 patients. Five to twelve years after the brain injury 44.6% of the patients had died, 26.1% were still in VS or MCS, but 18.5% had recovered to different degrees. Out of the followed up patients, 35% had originally shown the language-related N400 component, 65% had not. Out of the patients who had shown an N400 component during VS or MCS, 68 % regained consciousness. Out of the remaining patients who had not shown an N400 initially, only 12 (23.5%) had recovered to some degree by the time of the follow-up. This difference in distributions was highly significant (Fisher's Exact p<.001). Results indicate that the presence of the N400 ERP after severe brain injury predicts a favourable outcome even in patients with serve disorders of consciousness such as VS and MCS.

B8

THE EFFECT OF REPETITIVE TMS TO THE RIGHT INFERIOR PARIETAL CORTEX ON AUDITORY SPATIAL ATTENTION Debra S. Karhson[1], Edward J. Golob[1]; [1]Tulane University — Behavioral studies support the concept of an auditory spatial attention gradient, with attentional processing being a positive function of angular distance between stimulus and attended locations. Right inferior parietal cortex (rIPC) lesions can induce left spatial neglect, suggesting rIPC contributes to attentional gradients. This study examined the role of rIPC in auditory spatial attention by using event related potentials (ERPs) to define attention-related processing and repetitive transcranial magnetic stimulation (rTMS) to transiently interfere with rIPC activity. Subjects (n=10) listened to noise bursts at five azimuth locations (left to right: -90°, -45°, 0° midline, +45°, +90°) and responded to one target location (-90°, +90°, separate blocks). ERPs were analyzed before (baseline) and after (Post 1, 2) rTMS (1 Hz, 16 min) to the rIPC and focused on sensory (P200, ~200 ms latency) and attentional (P3a, ~300 ms latency) processing. For left and right target conditions the P3a to non-targets had linear increases in amplitude with greater distance from target locations (p<0.001), suggesting an attentional gradient. When attending to the right, P200 and P3a amplitudes were reduced in Post 1 vs. baseline (p<0.05), and returned to baseline in Post 2. P200 had amplitude decreases at -90°, followed by P3a reductions at all locations. Results suggest the rIPC is vital for establishing auditory attentional gradients when attending to the right. Effects of rTMS on the P200 and P3a suggest a time-course of rIPC-rTMS influence starting at locations farthest from the attended location and followed by a broader effect at all tested locations.

B9

AUDITORY EVENT RELATED POTENTIALS IN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AFTER A NEUROFEEDBACK TREATMENT Melissa Calderon[1], Ana Cristina Piñón[1], Josefina Ricardo-Garcell[1], Thalia Fernández[1], Thalia Harmony[1]; [1]Instituto de Neurobiología UNAM — Now days, one of the most common psychiatric problems found in children is the attention-deficit/hyperactivity disorder (ADHD), its prevalence is between 3 and 5% in children during the school time (American Psychiatric Association, 2000). Stimulant medications are preferentially used as a treatment of choice for ADHD. However, is well documented that medications fail to produce the desired improvement in behavior in a significant percentage of patients, from 30 to 40 % (Nash, 2000). Neurofeedback (NBF) has been used to treat children with ADHD and some advantages over the medications have been reported. It has been useful in the 80% of the subjects treated with this therapy (Lubar, 1999) and the changes produced have lasted (Tansey, 1993). However, there are few investigations in wich the neurobiological changes associated with the improvement in behavior associated with the NBF are explored. Twenty children with ADHD and excess of fronto-central theta activity who received 30 sessions of NFB were studied in this investigation. The main objective of this study was to see if the positive changes in behavior produced by NBF were reflected in the auditory ERPs. At the beginning and after the treatment auditory ERPs were recorded using the Test of variables of attention (TOVA) as the stimulation paradigm. After the treatment, reducing theta absolute power, positive changes in behavior were observed and those changes lasted two months after the treatment. Also, positive changes in the amplitude of the ERPs were observed after the treatment, compared with ERPs obtained before.

B10

DYNAMIC ATTENDING AND TEMPORAL PROCESSING IN PATIENTS WITH CEREBELLAR OR BASAL GANGLIA LESIONS Michael Schwartze[1], Sonja A. Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences — What mechanisms guide attention along temporally structured signals? Dynamic attending theory (DAT, Large & Jones, 1999) models attention as an oscillation that adjusts its phase and period in an attempt to synchronize internal resources with the temporal structure of external events, thereby allocating attention to specific points in time. As an instance of anticipatory stimulus-driven attending (Jones et al., 2002) this adaptation has to rely on an internal representation of temporal structure, possibly generated by neural systems implicated in temporal processing. The cerebellum (CE) and the basal ganglia (BG) are assumed to perform either pre-attentive, event-based or attention-dependent, interval-based temporal processing (Buhusi & Meck, 2005). To elaborate on these positions, the current study exploited the high temporal resolution of the Electroencephalogram (EEG) to investigate whether the amplitude of the event-related potential (ERP) associated with the attentive detection of change (P300) indicates the quality of synchronization in healthy and patient populations. The EEG was recorded from controls as well as patients with focal cerebellar or basal ganglia lesions while these participants directed their attention to two-tone auditory oddball sequences (600 Hz standard, 660 Hz deviant). The inter-stimulus-interval (ISI) in each sequence was manipulated to convey either isochronous or random temporal structure. Results suggest that this manipulation indeed has an impact on P300 amplitude. In comparison to controls and CE patients, the effect was strongest for BG patients. These findings support DAT as well as the proposed roles of the CE and the BG in pre-attentive, event-based and attention-dependent temporal processing, respectively.

B11

HOW DOES THE CONTEXT OF A REGULAR SOUND STRUCTURE MODULATE SENSORY MEMORY REPRESENTATIONS OF AUDITORY PATTERNS? Johanna Rimmele[1], Christian Keitel[1], Elyse Sussman[2], Thomas Jacobsen[1,3], Erich Schröger[1]; [1]Institue of Psychology, University of Leipzig, Germany, [2]Albert Einstein College of Medicine, New York, [3]Experimental Psychology Unit, Helmut Schmidt University / University of the Federal Armed Forces Hamburg, Hamburg, Germany — Listeners must cope with temporal fluctuations in the perception of speech and music and other complex auditory sequences. Patterns of temporal variability allow the perception of constancy in the presence of physical change. Not only complex and abstract regularities in sound structure, but also regularities of feature conjunctions are represented in sensory memory. However, there is little research on how multiple patterns of sound feature regularities are represented. In a passive Paradigm, we investigated how temporal and tone-frequency structure interact in sensory memory. In four experimental conditions, sounds were presented with: 1) a regular temporal and a regular frequency pattern (TF); 2) a regular temporal pattern (T); 3) a regular frequency pattern (F); 4) no regular pattern (N). Violations of regularities in feature conjunctions were controlled for to ensure that effects were caused by the structural sound context and not simple sound feature changes. The mismatch negativity (MMN) component of the event-related potential to temporal and frequency pattern deviations was recorded as a measure of sensory memory representation. An active protocol was used to measure behavioral detection performance. MMN was elicited by temporal and frequency pattern deviants in the TF and by frequency pattern deviants in the F condition. No MMN was elicited in the T condition. Behavioral detection of pattern deviants was highest in the TF condition. There was no evidence for an effect of a regular temporal context on sensory memory representations of the frequency structure of sound, but a regular frequency context modulated the temporal structure representation.

Attention: Development & Aging

B12

AUDITORY SELECTIVE ATTENTION IN 3- TO 5-YEAR-OLD CHILDREN Lisa D. Sanders[1], Lori B. Astheimer[1], Benjamin Zobel[1], Mara Breen[1], Lindsay Demers[1]; [1]University of Massachusetts, Amherst — Previous studies showed that event-related brain potentials (ERPs) elicited by auditory probes presented from the same locations as attended and unattended narratives differ beginning by 100 ms in 3- to 5-year-old children: a linguistic, spatially selective attention effect with an onset latency similar to what is reported for adults. We conducted two experiments to determine if this effect is dependent on domain (linguistic, nonlinguistic) or selection dimension (space, time). First, children were asked to attend to one of two simultaneously presented auditory environments (e.g., ocean sounds) to detect a target (e.g., fog horn) in the attended soundscape. As was shown previously with linguistic stimuli, ERPs elicited by auditory probes presented from the same locations as the attended and unattended environments differed beginning at 100 ms after onset. Second, we examined whether children direct temporally selective attention to the initial portions of words in continuous speech. Previous studies indicate that adults listening to a narrative direct attention to the times at which word-initial information is presented, resulting in differences in N1 amplitude elicited by probes played during the first 150 ms of words compared to control times. A temporally selective attention effect with similar onset latency was evident in children listening to stories. These results suggest that the effects of selective attention on auditory processing are robust in 3- to 5-year-old children across domain and selection criterion. Further, they make it possible to determine the specificity of the relationship between selective attention and receptive language processing abilities in this age group.

B13

ADULT AGE DIFFERENCES IN BOTTOM-UP AND TOP-DOWN INFLUENCES ON AUDITORY LATERALITY IN DICHOTIC LISTENING Susanne Passow[1], René Westerhausen[2], Isabell Wartenburger[3], Kenneth Hugdahl[2], Hauke R. Heekeren[1,4], Ulman Lindenberger[1], Shu-Chen Li[1]; [1]Center for Lifespan Psychology, Max Planck Institute for Human Development, Germany, [2]Cognitive Neuroscience Group, University of Bergen, Norway, [3]University of Potsdam, Germany, [4]Freie Universität Berlin, Germany — The right-ear advantage (REA), indicating superiority of the left hemisphere in speech processing, can be observed during verbal dichotic listening (e.g. Kimura, 1961). Recent studies with young adults focused on the interaction between bottom-up and top-down processes in affecting REA (e.g. Westerhausen et al., 2009). Initial evidence suggests that normal aging affects top-down attentional control of the REA. We investigated how normal aging alters (i) the interaction between bottom-up and top-down processes and (ii) lateralization of auditory processing. Twenty-four younger and 25 older adults were screened for their hearing acuity. Bottom-up stimulus characteristics were manipulated by gradually varying the inter-aural intensity differences. The degree of top-down modulation was manipulated by forcing attention to the right ear (FR), the left ear (FL), or none of the two ears (NF). The results of the behavioral study indicate: (i) bottom-up and top-down processes differ with age, as reflected in the significant four-way Attention x Ear x Intensity x Age interaction (epsilon=0.41, eta-squared=0.01); (ii) older adults' performance for a given ear depends more on inter-aural intensity differences (Intensity x Ear: epsilon=0.28, eta-squared=0.95) than younger adults' performance (Intensity x Ear: epsilon=0.23, eta-squared=0.71), indicating their reduced ability in exerting top-down control; (iii) relative to younger (RE>LE, Cohen's d=0.95) the REA is weakened in older adults (RE>LE, n.s.). These behavioral results are in line with evidence on senescent decline in attentional control and on alterations in hemispheric asymmetry during speech processing (Bellis et al., 2000). The follow-up EEG experiment will investigate neurophysiological correlates of these age-related differences.

B14

REDUCED AUDITORY MISMATCH NEGATIVITY TO LOUDNESS DISCRIMINATION IN CHILDREN WITH AUTISM SPECTRUM DISORDERS Bettina Mohr[1,2], Amanda Ludlow[1], Antony Whitmore[1], Max Garagnani[2], Friedemann Pulvermuller[2]; [1]Anglia Ruskin University, Cambridge, UK, [2]Medical Research Council, Cognition and Brain Sciences Unit, Cambridge, UK — Sensory symptoms are characteristic among individuals with autism spectrum disorders (ASD) and have been thought to relate to both language alterations and problems in social interactions. These sensory deviations appear to affect auditory processing, leading to hyper- or hyposensitivity to sounds and speech. 12 high functioning children (mean age 13.1 years) with a diagnosis of autism spectrum disorders and 12 typically developing children (mean age 13.4 years) participated in an auditory oddball task using speech sounds. Both groups were matched for verbal and nonverbal IQ and for handedness. In a mismatch negativity (MMN) paradigm, responses to changes in loudness were compared to those of stimulus length and changes in frequency. We found significantly reduced MMN responses to loudness deviants in ASD children compared to typically developing children. In contrast, other deviant stimuli produced similar MMNs in both groups. Further analyses showed that the stimulus-specific MMN difference in ASD children was due to deviant-elicited ERPs whereas standard responses were similar for both populations. Our data suggest hyposensitivity in detecting auditory changes in speech sounds in children with ASD, as reflected in a reduced MMN for deviant sounds of decreased loudness. We discuss the possible role of the MMN as a neurophysiological marker of change-type specific sensitivity in children with autism spectrum disorders.

B15

TRACING THE TYPICAL DEVELOPMENT OF AUDITORY AND VISUAL SUBCOMPONENTS OF ATTENTION AND WORKING MEMORY IN PRESCHOOL AGES Jacalyn Guy[1], Julie Hanck[1], Kim Cornish[1,2]; [1]McGill Child Laboratory for Research and Education in Developmental Disorders, McGill University, [2]Developmental Neuroscience and Genetic Disorders Laboratory, Monash University — The differential development of the subcomponents of attention and executive function in preschool ages is not yet fully understood. Consequently no clear trajectory of age-related changes in attention has yet been reported for this age group. Furthermore, the bulk of current research is focused primarily on the investigation of visual attention, which neglects the development of auditory attention and thereby a cross-modal perspective. However, the importance of delineating age-related changes of attentional proficiencies and deficiencies rests largely in their utility for understanding atypical developmental trajectories; specifically in neurodevelopmental disorders that are characterized by attentional difficulties. The focus of the present study is to first document age-related changes in sustained attention, response inhibition and working memory across the auditory and visual systems in typically developing girls and boys through the ages of 3-6 years. Furthermore, a second aim is to identify the modality specific differences as revealed by performance on analogous auditory and visual paradigms. An experimental computerized testing battery comprised of both auditory and visual continuous performance tests, Stroop-like adapted Day-Night tasks, and Noisy Book adapted tasks was used to assess sustained attention, inhibition and working memory, respectively. Preliminary results indicate that a developmental trend exists across all tasks, such that performance, specifically in terms of speed and accuracy, improves with age. Furthermore, performances for all visual tasks outpaced analogous auditory task performances, which suggest that auditory tasks are potentially more difficult than visual ones for this particular age group.

B16

METHYLPHENIDATE IMPROVES ATTENTIONAL ABILITIES OF RATS MADE IRON DEFICIENT IN EARLY INFANCY Wael Mohamed[1], Erica Unger[1,2], Byron Jones[1,3]; [1]Neuroscience Institute, Penn State University, [2]Nutritional Sciences, Penn State University, [3]Biobehavioral Health, Penn State University — Clinical studies indicate that iron deficiency early in life produces persistent, impaired cognitive and attentional abilities The aim of this study was to study the effects of methylphenidate, MPH on attentional deficits in rats made iron deficient (ID) early in life. The subjects for this study were Sprague-Dawley rats made iron deficient starting at postnatal day 4 by being placed on iron-deficient dams (vs. control). At weaning, all pups were placed on an iron-sufficient diet for the remainder of the study. At 45 days of age, the animals were tested for attention set shifting in a test consisting of 5 consecutive tasks, simple discrimination, compound discrimination, intra-dimensional reversal, extra-dimensional shift and extra-dimensional reversal. After testing, the animals were assigned to one of 4 MPH dose groups, 1, 5 or 10 mg/kg p.o. vs. vehicle control. Drug treatment continued for 15 days prior to a second round of attention set shift testing and continued throughout testing. Our results showed overall that ID rats performed more poorly than controls in all aspects of attentional set-shift testing. MPH at 1mg/kg and 5mg/kg significantly improved ID and control rats' performance; for the ID rats, lower doses were more effective than higher doses. These data support our hypothesis that early ID produces persistent effects on attention perhaps by impairing dopamine neurobiology. Moreover, we are the first group to show that methylphenidate can improve attentional processes in early iron deficient animals. Supported by a generous grant from the PSU Social Science Research Institute.

B17

AGE DIFFERENCES IN THE RECRUITMENT OF WIDESPREAD NEURAL NETWORKS: IMPLICATIONS FOR DISTRACTIBILITY Karen Campbell[1,2], Cheryl Grady[1,2], Lynn Hasher[1,2]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest — The present study used functional magnetic resonance imaging (fMRI) to examine age differences in brain activity during encoding in a distraction-laden task and the relationship between that activity and subsequent knowledge about the distraction. Older and younger adults were shown a rapid stream of letter strings (words and nonwords) superimposed on objects and were asked to perform a 1-back task on either the letters or the objects, with the attended modality manipulated across blocks. On a subsequent word fragment completion task, older adults showed more priming for the distracting words than younger adults. Furthermore, greater priming in the older group was associated with an inability to suppress activity in an area of the rostral prefrontal cortex (PFC) previously implicated in the default mode network. Younger adults, on the other hand, recruited a more lateral region of the rostral PFC, an area thought to be part of a frontal-parietal control network. Further functional connectivity analyses confirmed that these rostral regions were indeed distinct, with the older adults' more medial area being functionally connected to other default regions and the younger adults' more lateral area being connected to other control regions, including ventrolateral PFC and anterior inferior parietal regions. These results suggest that older adults' lessened attentional control, as indexed by their increased priming for the distracting words, is due to alterations in two major brain networks. That is, a failure to adequately suppress the frontal nodes of the default mode network and to simultaneously engage frontal nodes of the control network.

B18

TYPICAL TRAJECTORY OF ATTENTIONAL FUNCTIONING IN EARLY CHILDHOOD: PERFORMANCE ON MEASURES OF SELECTIVE, SUSTAINED, FOCUSED AND INHIBITORY CONTROL Julie Hanck[1], Jacalyn Guy[1], Kim Cornish[1,2]; [1]McGill Child Laboratory for Research and Education in Developmental Disorders, McGill University, [2]Developmental Neuroscience and Genetic Disorders Laboratory, Monash University — Understanding the typical trajectory of proficiencies and deficiencies within the cognitive domain of attention can provide critical information towards understanding atypical developmental trajectories. The aim of the present study was to chart the typical development of attentional processing in four subcomponents of attention: selective, sustained, focused and inhibitory control using a computerized battery (Amsterdam Neuropsychological Tasks) in 140 children ranging from 3 to 10 years of age. In addition, the mental age of each subject was assessed using the Peabody Picture Vocabulary Test (PPVT). The participants were divided into two groups; 1) 3 to 5 year olds and 2) 6 to 10 year olds. For the 3 to 5 year old group, results indicate that measures of speed and accuracy improved between the 3 and 4 year old groups across all subcomponents of attention suggesting that at four years they have reached a developmental plateau on this battery. Inattention as measured by misses on the GoNoGo task were the most frequent type of error made by three year olds but leveled off at four years of age. 2) For the 6 to 10 year old group, results indicate that measures of speed and speed variability improved across all tasks up until the age of 9 years old, where a developmental plateau appears to have been reached. There was no observed developmental trend on measures of accuracy across all tasks, with the exception of misses on the GoNoGo task suggesting that measures of accuracy may be dynamic across development.

B19

THE TEMPORAL DYNAMICS OF VISUAL ATTENTION IN ALZHEIMER'S DISEASE AND IN DEMENTIA WITH LEWY BODIES Frédéric Peters[1], Sylvie Belleville[1], Serge Gauthier[3], Pierre Jolicoeur[2], Anne-Marie Ergis[4]; [1]Institut Universitaire de Gériatrie de Montréal, Canada, [2]Université de Montréal, Canada, [3]McGill Center for Studies in Aging, Canada, [4]Institut de Psychologie, Université Paris 5, France — Objective: To study the temporal dynamics of visual attention in dementia with Lewy bodies (DLB) and dementia of the Alzheimer type (DAT) using the attentional blink paradigm (AB). This paradigm allowed us to examine patients' ability to attend to successive stimuli in close temporal proximity. Methods: Eighteen DAT patients, 15 DLB patients and 33 elderly controls were tested in a rapid serial visual presentation task. Participants were asked to report one (single-target condition) or two targets letters (T1 and T2) embedded in a sequence of distractors (i.e. digits). AB effect was measured as the deficit in identifying T2 when T1 was correctly reported. The temporal dynamics of AB was examined by varying the number distractors between the two targets. Results: The proportion of targets correctly reported was significantly lower in DLB group than in the DAT and control groups. Although an exaggerated AB effect was observed in both patient groups, this effect was significantly stronger in DLB patients as compared to DAT patients. Time-course analyses of the AB effect revealed that the control participants recovered to their single-target baseline after five intervening distractors (595 msec), whereas both DAT and DLB patients did not recover to their single-target baseline until there were nine intervening distractors (1071 msec). Conclusions: DAT and DLB patients show an increased difficulty of engaging attention twice within a short period of time. The results also suggest that attentional deficits in DLB are widespread and encompass low-level attentional processes that are not affected in DAT.

B20

A POSITIVITY BIAS IN OLDER ADULTS' ATTENTION TO SCENES? Jennifer Tomaszczyk[1], Myra Fernandes[1]; [1]University of Waterloo — According to the socioemotional selectivity theory (SST) older, relative to younger, adults place a greater emphasis on maintaining positive well-being, and this affects cognitive processing. Previous work (Mather & Carstensen, 2003) has shown that older adults are biased to avoid attending to negative information, particularly faces with negative expressions, relative to younger adults. We examined attentional biases in younger and older adults, but used realistic pictures rather than faces as stimuli. Pairs of pictures of different emotional valences (positive-neutral and negative-neutral) were briefly presented on a computer screen, followed by a dot, presented in the previous location of one of the pictures (right or left side of screen). Participants indicated the location of the dot as quickly and as accurately as possible. Response times (RT) were used to calculate attentional bias scores (Score = RT to detect a dot replacing a neutral picture – RT to detect a dot replacing a positive/negative picture), which indicated the degree to which participants' selective attention was biased toward positive, negative, or neutral pictures. Results showed that although both age groups were biased to attend to emotional relative to neutral pictures, younger adults had a greater bias to attend to negative pictures, whereas older adults had a greater bias to attend to positive pictures, though the interaction was not statistically significant. In line with SST, results suggest that younger adults' selective attention is biased toward negative information, whereas older adults' selective attention is biased toward positive information. This effect, however, is small and unreliable.

B21

AGE-RELATED CHANGES IN COGNITIVE CONTROL AND CONFLICT PROCESSING Kathryn Holt[1], Paul Kieffaber[1]; [1]College of William and Mary — The nature and specificity of age-related changes in cognitive function are topics of considerable debate. In the current study, age-related changes in the attentional and response-selection components of cognitive control were investigated using a novel task-switching procedure while recording EEG. Participants were asked to judge pairs of figures according to three rules (shape, size, or color). Two of the rules, shape and size, required a judgment about whether the two figures were the "same" or "different" on the dimension specified by the rule. The color rule required a decision about the color (red/blue) of the figure-pair. Because responses were indicated by pressing one of two buttons, some task-switches required an attentional-set switch while others required a switch of both attentional- and response-set. Moreover, this procedure engenders two distinct varieties of cognitive "conflict" permitting the determination of specific age-related changes in conflict processing. Significant differences in the response-times and the N2 component of the target-locked event-related brain potential between the varieties of conflict in younger participants indicate the integrity of distinct attentional- and response-set components of cognitive control. Age-related differences in behavioral and ERP measures, however, indicate a differential vulnerability to response-set conflict. These results suggest that deficits of cognitive control observed in normal aging may be specific to response-set conflict effects and the ability to implement a context-relevant response in the face of competing response alternatives. The specificity afforded by this procedure may also lead to an improved understanding of pathological changes in cognitive functioning associated with aging.

B22

AGE DIFFERENCES IN CONTROLLING THE CONTENTS OF WORKING MEMORY: EVIDENCE FROM PHASE AND AMPLITUDE MEASURES OF ALPHA OSCILLATIONS Markus Werkle-Bergner[1], Roman Freunberger[2], Myriam C. Sander[1], Wolfgang Klimesch[2]; [1]Max Planck Institute for Human Development, Germany, [2]University of Salzburg, Austria — Performance on working memory tasks declines with advancing age. Prominent theories of cognitive aging either suggest reduced processing speed or inhibitory control mechanisms to account for the observed age differences. On the neuronal level, oscillatory EEG activity in the alpha range (~10 Hz) is theorized to reflect cognitive processes related to memory and control operations. Therefore, the present study investigated whether age-differences in the ability to control the contents of working memory (WM) can be linked to a differential top-down modulation of phase-locked and non phase-locked alpha rhythms. Participants performed a modified sequential Sternberg-WM task while EEG was recorded. During WM encoding, cues instructed the participants either to maintain or to discard individual items from the memory set. Time-resolved spectral analyses revealed a stronger increase in upper alpha power (~10-12 Hz) for not-to-be-remembered items compared to to-be-remembered items in young adults. A similar effect was present in older adults. However, the spectral signatures were shifted towards the beta-range (~14-20 Hz). Given the importance of phase-locked alpha rhythms for the timing of neuronal inhibition, we discuss this finding in light of implications for the coordination of neuronal information processing in distributed networks in older adults. Furthermore, our results underscore the importance of individually tailored analysis strategies to derive valid conclusions in age-comparative studies of neuronal oscillatory activity.

B23

AGE AND INDIVIDUAL DIFFERENCES IN WORKING MEMORY CAPACITY AND SELECTIVITY: DIFFERENTIAL INSIGHTS FROM ERP AND TIME-FREQUENCY MEASURES Myriam Sander[1,2], Markus Werkle-Bergner[1], Ulman Lindenberger[1,2]; [1]Max Planck Institute for Human Development, Germany, [2]Berlin School of Mind and Brain, Germany — Visual working memory (WM) is characterized by its limited capacity and shows marked decline with advancing adult age. A fronto-parietal network thought to play a major role in the top-down selection and maintenance of information held in WM undergoes strong age-related changes. Recently, lateralized event-related potentials (ERP) were suggested to reflect interindividual differences in WM capacity and selectivity (Vogel et al., 2004). Therefore, in the present study, younger (20-25 years) and older adults (70-75 years) performed a cued change detection task. To allow for age-fair comparisons, load levels and presentation times were manipulated within and across age groups. In general, WM capacity was lower in older adults than in younger adults, and longer presentation times were associated with better performance. Lateralized ERP delay activity replicated the results of previous studies regarding individual differences in WM capacity during maintenance. However, these ERP markers were not associated with age group differences in WM performance. At the same time, early ERP components (P1N1 amplitude difference, N2pc) indicated that the task was perceptually more challenging for older adults than for younger adults. Amplitude and phase measures of alpha and theta oscillations revealed general age differences in selection and attention mechanisms during encoding and maintenance. We conclude that normal aging compromises several core mechanisms of visual WM that interactively limit capacity by diminished information uptake and less efficient top-down guidance.

B24

ATTENTIONAL PROCESSES IN AGING AND LEVEL OF EDUCATION EFFECTS IN AN ERP STUDY Chloé de Boysson[1], Jean-François Demonet[2], Sylvie Belleville[1]; [1]Research Center, Institut Universitaire de Gériatrie de Montréal, Montréal, Qc. Canada, [2]INSERM U825, Hôpital Purpan, Toulouse, France — Education has been suggested to modulate cognitive processes in healthy aging, but little is known regarding its effect on attentional control processes. This study aimed to explore divided attention and the ability to control attentional priority using ERPs and see how these processes differ in regard to educational level in older adults. A visual detection task and an alphanumerical equation verification task were completed under focused and divided attention conditions. There were three conditions of divided attention: one in which instructions asked for equal division of attention, one in which participants were asked to prioritize detection and one in which they were asked to prioritize equation. Thirty-one aged participants were studied as a whole and then split into 2 groups according to education. The effect of condition was found on the whole group for area under the peak and amplitude of N1 and P2 indicating that the detection condition differs from all the other conditions. An Education effect was found on the P2 area and N2 amplitude: these were higher for participants with a higher level of education than for those with a lower education level, and for all conditions. Furthermore, there was a positive correlation between performance in the equation task and N1 (amplitude), P2 and N2 (areas) for the highly educated group, whereas P3 component was negatively correlated with the detection performance for the low education group. The degree of attentional control modulates the ERP components. Educational level alters those components but irrespective of the attentional condition.

Attention: Multisensory

B25

HEROIN DEPENDENCE AND ATTENTIONAL BIAS: AN EVENT-RELATED POTENTIAL STUDY Rujie Qu[1,2], Yuejia Luo[2,3], Wenzhong Wang[2], Kan Shi[1,2]; [1]Graduate University of Chinese Academy of Sciences, Beijing, China, [2]Institute of Psychology, Chinese Academy of Sciences, Beijing, China, [3]Beijing Normal University, Beijing, China — This study investigated the attentional bias for drug-related stimuli in heroin dependent and normal subjects using an event-related potential technique. A modified cue-target paradigm was adopted with drug-related and neutral pictures as uninformative location cues. Event-related potentials were recorded for visual target stimuli that were preceded by these cues. In heroin dependent group, reactions were slowed down and the occipitoparietal P1 amplitude was reduced when targets appeared at the opposite location to drug-related pictures relative to neutral ones, whereas in normal control group, the P1 amplitude was reduced when targets appeared at the same location as drug-related pictures relative to neutral ones. These results suggest that the attentional bias caused by peripheral drug-related stimuli is able to modulate the visual inputs in early processing stages, and heroin addicts have difficulty to disengage their attentions from the drug-related information rather than engage to those stimuli.

B26

VISUAL-TACTILE UNIMODAL AND MULTISENSORY PROCESSING IN THE VISUAL PERIPHERY, AN FMRI STUDY Christina Karns[1], Mark Dow[1], Jolinda Smith[1], Scott Frey[1], Helen Neville[1]; [1]University of Oregon — Presumed unimodal sensory areas show surprising responses to other sensory modalities. These multisensory interactions are often reported for stimuli in the visual periphery. Processing in the visual periphery may be specifically implicated in cross-modal neuroplasticity and modified with intermodal attention. We aimed to determine the brain regions contributing to visual-tactile processing in peripheral vision and periocular touch and the extent to which unimodal and bimodal representations are modifiable by attention. In an fMRI experiment, participants detected targets in either the visual or tactile modality in unimodal visual, unimodal tactile, or bimodal blocks. Unimodal visual stimuli in the far-periphery (~45°) elicited increased BOLD signal in the anterior calcarine (acV1) and lateral occipital complex (LOC). Tactile stimulation of the periocular region of the face elicited increased BOLD signal in the parietal operculum (S1/S2). As predicted, regions implicated in the processing of bimodal visual-tactile stimuli depended on the attended sensory modality and included low-level sensory and multisensory areas. Visual attention elicited greater BOLD signal in acV1, V2, and LOC relative to tactile attention. Tactile attention to the same stimuli elicited greater BOLD signal in the parietal operculum (S1/S2) and temporal parietal junction (TPJ). When contrasting the response to bimodal with unimodal visual and tactile stimuli, a network of multisensory regions was implicated including the posterior middle temporal gyrus, TPJ, inferior frontal gyrus, LOC, and globus pallidus. These preliminary results suggest that attention is an important factor in both unimodal and multisensory processing and may influence the network of regions recruited for multisensory processing.

B27

SEEING OR NOT: VISION MODULATES TACTILE ATTENTIONAL SELECTION Bettina Forster[1], Helge Gillmeister[2]; [1]City University London, UK, [2]University of Essex, Colchester, UK — Vision of the hands while directing attention to one hand over short (transient) or longer (sustained) periods of time leads to earlier attentional modulations of somatosensory processing than when participants' hands are not visible. This effect of vision on tactile spatial selection of stimuli to one hand over the other could be explained by vision providing information about the hands in external space. The aim of the present study was to investigate whether vision of the hands also affects attentional selection when the relative location of the hands was irrelevant and attention was either directed to the body or away from it. Participants were presented with an alternating stream of tactile and auditory stimuli presented to the right or left hand and from a central speaker while their hands were either visible or covered from view. In separate blocks participants were counting infrequent auditory or tactile deviants while ignoring stimuli in the other modality. ERPs to tactile stimuli were analysed under conditions were these were either attended (count touches) or unattended (count sounds). When hands were visible, attentional modulations were already present for the time range of the N80 component, but when hands were covered from view only later attentional modulations, starting in the time range of the P200, were present. Therefore, vision of the body strongly affects the mechanisms underlying attentional selection of touch. Importantly, the functional mechanisms of such vision effects are not restricted to providing information about the location of the hands in external space.

B28

VISUAL SEARCH EFFICACY IN YOUNG AND MIDDLE-AGED ADULTS: HOW CAN AUDITORY CUES HELP? Paula M. McLaughlin[1], Jill B. Rich[1,2], Nicole D. Anderson[3,4], Susan J. E. Murtha[1]; [1]York University, [2]Baycrest Centre, [3]Kunin-Lunenfeld Applied Research Unit, Baycrest, [4]University of Toronto — The ability to visually search one's environment is a complex skill used everyday. Success at finding a particular object is dependent on a variety of factors, including search strategy, the ability to ignore distracting items, efficiency in shifting attention, and age. As demonstrated in our lab and elsewhere, when participants are provided with an informative visual cue (i.e., visually cueing a location) target detection is facilitated during simple and more complex visual searches in young and older adults. In the present study, we investigated whether auditory cues can also facilitate visual search performance, and whether these effects are dependent on the type of cue (informative spatial cue vs. non-informative preparatory cue) and the age of the participant (young vs. middle-aged). Participants were presented with two visual search tasks: orienting (informative cues) and preparatory (non-informative cues). In each task search condition (single, conjoined), array size (5, 9, 17), target presence, and cue availability were manipulated. Results showed that middle-age adults were less efficient on complex visual searches relative to younger adults. Additionally, auditory cues facilitated visual search performance similarly in young and middle-aged adults. Although the preparatory cues improved performance, facilitation was dependent on search condition, array size and target presence. Furthermore, the cueing effects observed on the orienting task were larger and more widespread. These findings indicate that auditory cues can improve visual search efficacy, particularly when the cue is spatially informative.

B29

THE COMT VAL158MET POLYMORPHISM MODULATES STATE ANXIETY AND NEURAL HABITUATION IN REGIONS INVOLVED IN ATTENTION Isabella Mutschler[1], Birgit Wieckhorst[1], Markus Klarhöfer[3], Frank H. Wilhelm[1], Franz Müller-Spahn[1], Andreas Papassotiropoulos[1], Erich Seifritz[5], Tonio Ball[6,7]; [1]University Basel, Switzerland, [3]MR-Physics, University Hospital Basel, Switzerland, [5]Clinic for Affective Disorders and General Psychiatry, Psychiatric Hospital Zurich, [6]Bernstein Center for Computational Neuroscience, University of Freiburg, Germany, [7]Epilepsy-Center, University Hospital Freiburg, Germany — The Catechol-O-methyltransferase (COMT) val158met polymorphism influences catecholamine neurotransmission and is postulated to influence cognitive functions [1]. The exact mechanisms are not clear. Here, we investigated 103 healthy females (mean age = 23.7, SD = 3.36, range = 18 - 35, all right handed) using functional magnetic resonance imaging (fMRI). State anxiety was assessed before and after the experiment. State anxiety reflects a human transitory emotional state or condition that is characterized by subjective, consciously perceived feelings of tension and apprehension [2]. During fMRI, movies of laughing and crying babies were presented to the subjects, who carried out subjective ratings of the movies. We found that the mean anxiety level significantly increased throughout the fMRI experiment's period exclusively in the val/val carriers. Furthermore, at the same time scale, val/val carriers also showed a faster neural habituation as parametrized by a faster decline in the stimulus-induced blood oxygen level-dependent signal, in the temporo-parietal junction (TPJ) area ($p < 0.05$, FWE-corrected). We conclude that state anxiety can be increased in val/val carriers and that his may contribute to cognitive performance differences due to the COMT polymorphism. Furthermore, altered TPJ responses – an area implicated in attentional processes – may play a role in the underlying neuronal mechanisms. 1. Aleman et al., (2008) 2. Spielberger et al., (1970)

B30

ATTENTION DEPENDING INFLUENCE OF OLFACTION DURING NEUROBAVIORAL TASKS Kathrin Hey[1], Stefan Kleinbeck[1], Edmund Wascher[1], Christoph van Thriel[1]; [1]Leibniz Research Centre for Working Environment and Human Factors — Neurobehavioral tests are used to assess health effects in exposed working populations as well as to provide data for the setting of health based threshold limit values (TLVs). Beside the neurotoxicological effects due to different substances, already an annoying odor might cause deficits in performance. In our experiment we focused on the effects caused by hydrogen sulfide (HS), a substance with an unpleasant smell comparable to the foul odor of rotten eggs. During four-hour HS exposures different neurobehavioral tasks were carried out: inhibition of return, visual and visuospatial working memory and response inhibition. In order to study the attention depending influence of olfaction, a high concentration (mean: 5 ppm) and a low concentration (mean: 0.5 ppm) were applied in combination with two attentional conditions. In the focused attentional condition, participants had to count the exposure peaks, whereas in the non-focused condition they were told that exposure peaks were mainly determined by technical reasons. Reaction time and error rate were taken for each task, psychophysical ratings were recorded every half hour during HS exposure. Regarding the inhibiton of return task and the working memory tasks, the behavioral results yield an interaction between attention and concentration. A main effect of concentration could not be found. During the high exposure condition the attentional focus enforces distractive effects, while during the low exposure condition the attentional focus diminishes distractive effects. Concerning the attentional capture, it might be the combination of exposure level and attentional focus that leads to poorer performance.

B31

THE PROCESSING OF IRRELEVANT INFORMATION IN A MULTISENSORY CONFLICT PARADIGM Sarah Donohue[1], Alexandra E. Todisco[1], Marty G. Woldorff[1]; [1]Center for Cognitive Neuroscience, Duke University — Selective attention to one modality in the face of distracting stimuli is crucial to successful behavior. In multisensory conflict, attention is thought to enhance processing in the relevant modality, as suggested by some fMRI studies. It is less clear, however, what type of processing occurs in the sensory cortex processing the distracting information, and when such modulations might occur. To determine the time-course of distractor processing during multisensory conflict, we collected EEG data during an auditory attention task. Participants attended to the auditory modality to make a letter discrimination on each trial, while simultaneous, task-irrelevant, bilateral visual stimuli were presented that could be fully congruent, partially incongruent, or fully incongruent with the auditory stimulus. On half the trials, a bilateral visual probe stimulus was presented 500-700 ms post-multisensory-stimulus onset to determine the attentional allocation to the visual modality after the different trial types. EEG time-locked to the multisensory-stimulus onset revealed a centrally distributed negative wave starting ~300 ms that was greater for incongruent than congruent. Time-locked averages to the probe stimuli revealed that when they followed a fully or partially incongruent multisensory stimulus there was a significantly enhanced N1 and P2 response, relative to following a congruent stimulus. These data suggest that instead of the irrelevant information being suppressed, it acts as a distracting draw of attention, pulling more attention toward the irrelevant modality, at least at the time of these probes. These results highlight the need to assess the multifaceted time course of the brain's responses to stimulus conflict.

B32

THE INTERACTION OF EXPECTANCY AND SOMATIC ATTENTION ON THERMAL PAIN PERCEPTION Natalie E. Johnston[1], Lauren Y. Atlas[1], Tor D. Wager[1]; [1]Columbia University — Pain is a complex psychological construct that may be evaluated differently and engage disparate processes depending on how its significance is interpreted. A wealth of research suggests both that attention to pain and expectations about pain intensity strongly influence self-reported pain. However, it is unclear if these processes modulate pain independently, or whether they interact to influence pain perception. In this study, we examined whether expectancy and somatic focus interact to modulate perceived pain. Auditory cues elicited expectations for low or high pain. On a subset of trials ("expectancy violations"), these cues were followed by a single temperature calibrated to elicit moderate pain. Throughout the experiment, a divided attention procedure directed attention toward or away from the body during noxious thermal stimulation. The results of expectancy replicated previous findings from our lab, indicating that medium trials were rated as more painful when preceded by high pain cues than low pain cues. There was also an effect of pain expectancy on attention: High pain (versus low pain) expectancy resulted in greater performance on the task drawing attention toward the body. Finally, the effects of somatic focus were surprising: With high pain expectancy, pain was greater when attending away from the body than when attending to the body. The findings suggest that trying to ignore pain by attending elsewhere may be counter-productive, particularly when pain is expected to be intense. A more effective pain-control strategy under such circumstances might be to attend to and make judgments about the non-affective aspects of pain.

Emotion & Social: Development & Aging

B33

DEVELOPMENT OF AMYGDALA SPECIALIZATION IN FEAR PROCESSING Yuwen Hung[1,2], Mary Lou Smith[2], Margot J. Taylor[1]; [1]Diagnostic Imaging, Research Institute, The Hospital for Sick Children, Toronto, Canada, [2]University of Toronto Mississauga, Mississauga, Canada — The ability to detect potential threats, as can be represented in fearful faces, involves neural systems that facilitate fast responses for adaptive behaviour. The amygdalae are known for their role in processing emotions such as fear. To date little is known regarding the development of this specialization of the amygdalae in emotion processing. We examined the amygdalae responses to facial emotions in children (aged 7 – 10 and 12 – 15 yrs; n=13/group) using magnetoencephalographic (MEG), 151 channel CTF system. We applied a simple target-detection task during MEG recordings, in which a scrambled pattern (target) and an emotional face (happy, fearful or neutral) were presented simultaneously in the peripheral hemifields. Source analyses used the anatomical MRIs of each participant. Results showed left amygdala activation in the younger children in response to fearful and happy emotional faces, while the older children showed right amygdala activation only to the fearful emotion, all compared to the neutral faces. We also observed activation in the anterior cingulate cortex (ACC) in the older children responding to the fearful relative to the neutral faces. The MEG source activations in the older children were similar to what we have found in adults. Our results suggest that the amygdalae responses to emotions undergo qualitative developmental changes. These data provide developmental profiles of the amygdala-ACC responses to fearful faces related to functional specialisation and lateralisation in these brain regions in children.

B34

MEASURING THE FUNCTIONAL SIGNIFICANCE OF A CLINICAL ALLOSTATIC LOAD INDEX IN OLDER ADULTS AND WORKERS Robert-Paul Juster[1,2,3], Sonia Lupien[2,3]; [1]Integrated Program in Neuroscience, McGill University, [2]Fernand-Seguin Research Centre, University of Montréal, [3]Laboratory of Psychoneuroendocrinology of the Centre for Studies on Human Stress — Allostatic load (AL) refers to biological wear and tear caused by chronic psychosocial stress. The AL model proposes that by measuring the multi-systemic interactions among sub-clinically relevant biomarkers, biomedical advances can be made in the detection of individuals at high risk for stress-related diseases. By incorporating an AL index encompassing neuroendocrine, immune, metabolic, and cardiovascular biomarkers, a growing body of literature has demonstrated augmented prediction of numerous deleterious outcomes. Unfortunately, the current formulation is based on biomarker values from individual studies, which limits the biomedical utility of this promising technology. Using a new AL index based on clinical reference ranges, we investigated physical and psychological outcomes in two studies. In Study 1, 85 older adults were followed longitudinally over eight years, while Study 2 included 30 younger workers assessed cross-sectionally. We hypothesized that increased AL indices based on 7 and 15 biomarkers would relate to increased levels of psychosocial stress, dysregulated diurnal and reactive stress hormone levels, subjective memory and physical complaints, explicit and declarative memory impairments/declines, and finally symptoms of depression and burnout. Our results support our predictions for specific age-related outcomes. For older adults, higher AL predicted greater depressive symptoms three years in advance with cognitive impairments/declines. For younger workers, higher AL was manifested physiologically and symptomatically as a pre-burnout condition with the absence of cognitive and physical complaints. These findings provide strong preliminary support for a new clinical AL index sensitive to specific stress-related problems throughout the life span that is, moreover, easily accessible to health-care providers.

B35

DEPRESSION IN PARKINSON'S DISEASE: A CORTICAL EXPLORATION Thomas Jubault[1,2], Jean-François Gagnon[1], Alain Ptito[4], Alan Evans[5], Oury Monchi[1,2]; [1]Université de Montréal, [2]Unité de Neuroimagerie Fonctionnelle, Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal, [4]Montréal Neurological Institute, McGill University, [5]McConnell Brain Imaging Centre, McGill University — Idiopathic Parkinson's disease (PD) is a neurodegenerative disorder diagnosed on the basis of motor symptoms. PD is characterized by a subcortical pattern of lesions, though neuronal loss occurs in the cortex in later stages of the disease. Patterns of cortical neuronal loss have not been consistently identified with traditional techniques. Additionally, depression is a well known feature of the disease, while its origin and association to other symptoms remains unclear. Therefore, we investigated the cortical degeneracy specific to PD and to the occurence of depressive symptoms. We acquired high resolution MRI T1 weighted sequences for 30 healthy controls (HC) and 43 PD patients. CIVET pipeline was used to extract cortical surfaces. Locally registered cortical thickness was modelled as a linear function of age and condition for each participant, and as a function of age and depression in the PD group only. Global cortical thickness is globally lower in the PD group than in the HC group, with accentuated thinning in the pSMA. We also found that the right lateral prefrontal cortex is associated with a worsened depressive condition. These preliminary results suggest that PD with depressive symptoms is associated with structural modifications in the prefrontal cortex. It should be noted that this region, among other, is involved in executive processes that are subject to deficits in PD. The identification of consistent patterns of neuronal loss through cortical thickness analysis could lead to the definition of stable subgroups in degenerative disease such as PD.

B36

SOCIAL AND DEVELOPMENTAL FACTORS PREDICT DIFFERENCES IN EMOTIONAL REACTIVITY AND REGULATION Jennifer A. Silvers[1], Margot A. Schel[2], Katherine A. Remy[1], Kevin N. Ochsner[1]; [1]Columbia University, [2]Leiden University — Recent research suggests that adolescence is a "make or break" time for the development of effective emotion regulation skills. However, little empirical work has examined how emotion regulation capacity changes during adolescent development. It has also been suggested that adolescents are more sensitive to negative social cues than adults but this hypothesis has not been formally tested. The present study investigated whether, over the course of adolescence, 1) emotion regulation success increases and 2) reactivity to negative social emotional stimuli decreases. Individuals at the beginning (10-13 years), middle (14-17 years) and end of adolescence (18-22 years) completed an emotion regulation task. On each trial, participants viewed a negative or neutral picture while either drawing themselves closer to the emotional details of the picture ("close") or mentally distancing themselves from such details ("far"). Half of the pictures viewed contained social content. After each trial participants rated their negative affect. Participants of all ages reported less negative affect in response to negative stimuli on "far" trials than "close" trials but older participants were more effective (as evidenced by a larger drop in negative affect) at using the "far" strategy when viewing negative stimuli than younger individuals. Additionally, younger participants reported more negative affect in response to negative social stimuli than older participants. Skin conductance responses mirrored age and task-dependent differences in negative affect. These behavioral and physiological findings suggest that emotion regulation success improves over adolescence as emotional reactivity to negative social cues attenuates.

B37

DEVELOPMENTAL CHANGES IN THE RELATIONSHIP BETWEEN EMOTION AND COGNITION Nicole Strang[1], Seth Pollak[1]; [1]University of Wisconsin-Madison — There has been little research investigating whether there are developmental changes in the relationship between emotion and cogniton. This is an important area of research as it has been hypothesized that the relationship between the prefrontal cortex (PFC) and limbic system changes across development (Casey et al., 2008, Sommerville et al., 2009). In this block design functional MRI investigation forty participants between the ages of 12 and 21 (12-15-years, n=20, 18-21-years, n=20) completed a task with cognitive and emotional components. The task involved two categories of problems: math, and math+stress. In the math condition they responded to math problems, and in the math+stress condition participants responded to more difficult math problems with a time limit titrated for each participant to ensure an accuracy rate of 40%. During the paradigm participants were informed that they were performing poorly in the math+stress condition, and needed to try harder.FMRI data were analyzed for differences between the math and math+Stress condition and differences between the age groups. Relative to the Math condition the math+Stress condition resulted in a network of increased activation including the dorsal anterior cingulate cortex (dACC), bilateral anterior insula, and dorsal lateral PFC (DLPFC) for both age groups. Age-related differences were specific to the Math condition, where adolescents showed greater activation in the left anterior insula relative to the adults. The results were interpreted as evidence for improvements emotion-regulation across development, as the insula (a stress-related brain region) remained activated in the adolescents in the absence of the stress.

B38

FRONTOSTRIATAL MATURATION PREDICTS BEHAVIORAL REGULATION FAILURES TO APPETITIVE CUES IN ADOLESCENCE Leah Somerville[1], Todd Hare[1,2], BJ Casey[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Cornell Medical College, [2]California Institute of Technology — Adolescence is associated with enhanced risk-taking behavior, potentially related to enhanced motivation to approach potential rewards relative to immature behavioral regulation. This study aimed to determine the contributions of frontostriatal circuits in approach motivation and behavioral regulation using an emotional Go No-Go task. During fMRI scanning, child, adolescent, and adult participants approached ("Go" trials) or suppressed an approach behavior ("No-Go" trials) to neutral and happy faces. Participants were more motivated to approach the happy stimuli as evidenced by faster response times. A summary performance measure (d′) revealed that while children and adults performed better for happy relative to neutral trials, adolescents failed to show this behavioral facilitation, driven by adolescents' enhanced false alarm rates on trials in which approach behavior should have been suppressed (happy no-go). The ventral striatum demonstrated maximal sensitivity to happy trials in adolescents. During correct suppression trials, we observed greater recruitment of the ventrolateral prefrontal cortex (IFG) the younger the participant which also predicted performance, such that individuals who were less successful at suppressing approach responses yielded greater recruitment for successful suppression trials. Adolescents showed greater coupling within frontostriatal networks during happy trials, relating interactions within frontostriatal circuits to developmental shifts in approach and behavioral regulation at the level of the striatum (ventral and dorsal). Taken together, these findings suggest that adolescence is marked by reduced behavioral suppression to potential rewards, which may result from hypersensitivity of ventral striatal responses to appetitive cues paired with prefrontal regulatory responses that are not fully mature.

B39

TRAUMA AND THE DEVELOPING BRAIN: NEUROIMAGING EVIDENCE FOR LONG-TERM STRESS-RELATED NEURAL CHANGE IN HEALTHY CHILDREN Barbara Ganzel[1], Heather Gilmore[1], Nim Tottenham[2], Elise Temple[3]; [1]Cornell University, [2]Univerity of California at Los Angeles, [3]Dartmouth College — Is there a long-term impact of life stress on the brains of healthy children (i.e., in samples known to be free of clinical disorder)? Using fMRI, we imaged fifteen healthy children (10 male, 5 female, 12.9 ± 2.2 years) while they passively viewed fearful and calm faces in order to examine the association between prior life stress and amygdala function. All of the children resided in the New York metropolitan (NYC) area and all were screened to exclude physical and mental disorder. Most of the children had been in the NYC area during the terrorist attacks on the World Trade Center on 9/11/01, which was between 5.7 to 6.1 years prior to the time of imaging. We found significant increases in amygdala reactivity to emotional faces (fearful versus calm) with increasing proximity to the World Trade Center on 9/11/01 (? = -.67; p < .01). The average number of traumas in lifetime in this sample was 2.6 ± 1.7 traumas, and we found increases in amygdala reactivity (F > C) with increasing number of traumas in lifetime for these children (? = .64; p = .01). Frequency of trauma exposure was associated with current child anxiety (? = .77; p < .01) and anxiety was associated with amygdala reactivity (? = .75; p = .04: ROI from whole brain voxel-wise t-test [F>C]). These data provide evidence for long-term stress-related neural change in healthy children, which in turn is associated with current anxiety.

B40

BE RATIONAL: GOAL UNDERSTANDING IN THE AUTISTIC BRAIN Antonia Hamilton[1], Lauren Marsh[1]; [1]University of Nottingham, UK — When typical adults see a child reach for a cookie, brain areas involved in comprehending action goals are reliably activated. Some theories claim that these neural systems, including the human mirror neuron system, may be dysfunctional in individuals with autism. This study aimed to test this hypothesis, comparing responses in typical and autistic brains during observation of rational and irrational goal-directed hand actions (GDHA). 18 high-functioning adults with autistic spectrum disorder and 19 age and IQ matched typical adults took part. During fMRI scanning, participants watched movies depicting (1) GDHA with a rational (straight) trajectory (2) GDHA with an irrational (curved) trajectory (3) GDHA which rationally curved over an obstacle (4) GDHA which irrationally moved straight through the obstacle or (5) shapes moving linearly over a plain background. Both typical and autistic groups showed similar levels of activation in middle temporal gyrus, anterior intraparietal sulcus and dorsal premotor cortex when viewing hand actions compared to viewing moving shapes. This suggests that basic neural responses to observed actions are not abnormal in autism. Critically, a group by rationality interaction was found in medial prefrontal cortex: only typical participants distinguished between rational and irrational actions in this region. This shows that brain areas associated with mentalising also respond to irrational actions in typical individuals, but this response may be abnormal in adults with autism. The broad implications of these results for understanding typical and autistic action comprehension and social interaction will be discussed.

B41

PITUITARY VOLUME PREDICTS INTERNALIZING SYMPTOMS IN ADOLESCENCE Sarah Whittle[1], Amy Zipursky[2], Murat Yücel[1], Valentina Lorenzetti[1], Nicholas Allen[1]; [1]The University of Melbourne, [2]The University of North Carolina — Early adolescence is a critical period for the development of both internalizing and externalizing disorders. Stress dysregulation has been identified as a key contributing factor in the development of both arms of psychopathology. Pituitary volume may be a useful way to index stress dysregulation in this context, as it has been associated with hypothalamic-pituitary-adrenal (HPA) axis function, and found to be abnormal in a range of psychopathologies. However, it is not clear whether abnormal pituitary volume may be associated with risk for psychopathology. In a community sample of 154 early adolescents, we examined whether pituitary volume was able to prospectively predict change in internalizing or externalizing symptoms over a 2.5 year period. Participants were screened for psychopathology, underwent a magnetic Resonance Imaging (MRI) scan, and completed an assessment of self-reported depressive, anxiety, and externalizing symptoms. At follow-up, adolescents again completed the CES-D, BAI, and CBCL. We found a significant relationship between larger pituitary volume and an exacerbation of both anxiety and depressive symptoms over time. As larger pituitary volume is thought to reflect high activity of the HPA axis, these results suggest that hyperactivity of the HPA axis could be an important biological risk factor for the development of internalizing disorders in adolescence. In contrast, we did not find a relationship between pituitary volume and change in externalizing symptoms, pointing to the specificity of our findings. These findings provide further support for the utility of incorporating methods of altering HPA axis activity into psychosocial intervention for internalizing disorders.

Emotion & Social: Other

B42

EYETRACKING TO SOCIAL SCENES: COMPARISONS BETWEEN AMYGDALA LESIONS AND AUTISM Elina Birmingham[1,2], Moran Cerf[1], Ralph Adolphs[1]; [1]California Institute of Technology, [2]Simon Fraser University — The amygdala plays a critical role in orienting gaze and attention to socially salient stimuli. We previously found that SM, a patient with rare bilateral amygdala lesions, was unable to recognize fearful facial expressions because she failed to fixate the eyes in faces. Amygdala dysfunction has also been implicated as a contributing factor in autism, consistent with some findings that individuals with autism show reduced fixations to eyes in faces. Yet detailed comparisons between autism and patients with amygdala lesions have rarely been undertaken. Here we carried out such a comparison, using eyetracking to complex social scenes that contained faces. Participants were shown scenes depicting several people under three main conditions: they either had to report on what kind of room the scene was taking place in (Neutral), describe the scene (Describe), or infer what the people in the scene were attending to (Social Attention). SM looked less at the eyes and much more at the mouths of people in the scenes relative to control participants, especially in the Neutral condition, consistent to how she directs her gaze to real people. Individuals with autism, by contrast, did not show this pattern but instead showed more subtle abnormalities. These results suggest that amygdala damage leads to a specific reduction of exploration of other people's eyes. However, individuals with high functioning autism do not exhibit robust social orienting deficits, at least when using static pictures of social stimuli.

B43

DO YOU SEE WHAT I SEE?: THE NEURAL BASES OF JOINT ATTENTION DURING A LIVE INTERACTIVE GAME Elizabeth Redcay[1], David. Dodell-Feder[1], Mark J. Pearrow[1], Mario Kleiner[2], Penelope L. Mavros[1], Jing Wang[1], John D. E. Gabrieli[1], Rebecca Saxe[1]; [1]Massachusetts Institute of Technology, [2]Max Planck Institute for Biological Cybernetics — Joint attention refers to the ability to coordinate one's own attention with another on a third entity (e.g. object or common goal). This uniquely human ability emerges late in the first year of life and is critical to social-cognitive and language development; yet the neural bases for this pivotal skill remain largely understudied. Joint attention includes both Responding to Joint Attention (RJA), or following another's bid for shared attention on an object, and Initiating Joint Attention (IJA), or initiating a bid for shared attention on an object. To identify the neural bases of both IJA and RJA we implemented a dual-video set-up in which both subject and experimenter could monitor each other via video feed in real-time during fMRI data collection. In each trial, participants either followed the experimenter's gaze to a target (RJA) or cued the experimenter to look at the target (IJA). A control condition, non-joint attention (NJA), was included in which the subject shifted gaze to a target while the experimenter closed her eyes. Greater activation was seen in the dorsal medial prefrontal cortex (dMPFC) and bilateral posterior superior temporal sulcus (pSTS) during joint attention (IJA + RJA) as compared to NJA. RJA elicited greater activation in posterior superior temporal sulcus (pSTS) than NJA while IJA recruited greater activation in dMPFC than NJA. This novel experimental set-up allowed for the first time identification of the neural bases of both initiating and responding to joint attention.

B44

THE NEUROPHYSIOLOGICAL CORRELATES OF JUDGMENTS OF MORAL AND CONVENTIONAL VIOLATIONS Ayelet Lahat[1], Charles C. Helwig[1], Philip David Zelazo[2]; [1]University of Toronto, [2]University of Minnesota — Greater activation within the prefrontal cortex has been found for moral versus non-moral judgments (e.g., Greene et al. 2004). However, prior research has not examined the possible neural correlates of the distinction between moral and conventional violations (e.g., Turiel 2008). Moral violations (e.g., hitting), in contrast to conventional violations (e.g., a boy wearing a dress), are not contingent on the presence of rules, and are usually considered wrong even in the absence of a rule (e.g., Nucci, 1981). The present study examined whether the two types of violation are associated with different neurophysiological correlates, and focused on the N2, an event-related potential (ERP) usually observed 200-400 ms post-stimulus at medial-frontal sites (Lewis et al., 2006). ERPs were recorded from 30 undergraduates who participated in a task that presented neutral, conventional, and moral violations. Participants judged whether the act was acceptable or unacceptable in the presence and absence of a rule. Results indicated that when a rule was present, N2 amplitudes were significantly larger (more negative) for conventional than moral violations, but in the absence of a rule, N2 amplitudes for moral violations were as large as conventional violations. For all violations, N2 amplitudes were largest on the right scalp, as compared to the left and center scalps, but the effect was strongest for conventional violations. The findings support the distinction between morality and conventions and suggest that moral violations may be judged automatically when a rule is present, but require overcoming an automatic response in the absence of a rule.

B45

EMOTIONAL PROSODY PROCESSING IN PARKINSON'S DISEASE: SIDEDNESS OF MOTOR SYMPTOMS MAKES THE DIFFERENCE Patricia Garrido-Vásquez[1], Marc D. Pell[2], Silke Paulmann[3], Karl Strecker[4], Johannes Schwarz[4], Sonja A. Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]McGill University, Montréal, Canada, [3]University of Essex, UK, [4]University of Leipzig, Germany — Several studies have suggested emotional processing deficits in patients with Parkinson's disease (PD). However, most of these studies are behavioral, and thus do not shed light on the time course of emotional processing in PD. Also, little is known about possible differences between patients with left-dominant versus right-dominant motor symptoms, which is especially important considering views of hemispheric specialization in the brain for emotional processing. To address these issues, we conducted an event-related potentials study on the processing of emotional prosody in PD. Patients listened to well-formed (lexical) German sentences and sentences in pseudo-speech in five different emotional tones (angry, disgusted, frightened, happy, neutral). Attention to emotional content was manipulated by using an implicit (lexical decision) or explicit (emotional decision) task. We differentiated between patients according to their more affected body side. The left PD group (LPD) showed early processing deficits in the P200 time window and their ERP response was generally more positive-going than in healthy controls, whereas the right group (RPD) manifested deficits later in time, i.e. in a late positivity, with no difference between lexical and pseudo-sentences while controls showed this differentiation. These results suggest that the dominantly involved body side may affect different processing mechanisms underlying emotional prosody. We suggest that LPD patients, whose right basal ganglia are dominantly affected, have difficulty to detect emotional salience (enlarged P200), while RPD patients (left basal ganglia more affected) show deficient integration of prosodic and semantic information reflected in the late positivity.

B46

MORAL HYPERSENSITIVITY IN OBSESSIVE-COMPULSIVE DISORDER Hanah Chapman[1], Tania Georgescue[2], Neil Rector[3], Peggy Richter[3], Arun Ravindran[2], Adam Anderson[1]; [1]University of Toronto, [2]Centre for Addition and Mental Health, [3]Sunnybrook Health Sciences Centre — While there has been considerable interest in individuals who are relatively insensitive to socio-moral norms (i.e., psychopaths), less is known about those at the other end of the spectrum, individuals who are morally hypersensitive. We examined moral cognition in obsessive-compulsive disorder (OCD), a condition in which excessive concerns about immorality are common. Patients and controls completed a questionnaire measure of concerns about committing moral transgressions, and subsequently underwent fMRI while making judgments about social and moral transgressions as well as neutral control acts. Preliminary results indicate that individuals with OCD are indeed hypersensitive to moral transgressions: patients judged transgressions more harshly than controls, and also had stronger concerns about committing moral transgressions. Moreover, in response to moral transgressions but not neutral acts, patients showed higher activation in affective processing regions such as bilateral mid-insula and mid-cingulate as compared to controls. By contrast, patients had lower activation for moral transgressions in the precuneus and right lateral parietal regions. These results suggest that moral hypersensitivity in OCD may be mediated by increased emotional and decreased cognitive responses to transgressions.

B47

ATYPICAL PAIN EMPATHY IN YOUNG OFFENDERS WITH CALLOUS-UNEMOTIONAL TRAITS: AN ERP STUDY An-Yi Hung[1], Jean Decety[2], Yawei Cheng[1]; [1]National Yang-Ming University, [2]University of Chicago — Empathy disruption is one of the core characteristics in youth with callous-unemotional (CU) traits. However, how the CU traits disrupt the neural underpinning of empathy remains to be determined. The study measured the ERP elicited by pain empathy in 15 controls (mean age = 17.53 ± 1.76 yrs), 15 offenders with Conduct Disorder (CD) (mean age = 16.73 ± 0.99 yrs) and 13 offenders with CU traits (mean age = 16.88 ± 0.84 yrs). Immediately after being presented with the static pictures depicting someone's limbs in painful and non-painful situations with intentionality (Agent pain/Neutral) or not (Limb pain/Neutral), the participants were required to perform a pain judgment task. Mean ERP voltages were obtained from each grand average peak, starting from the onset of each visual stimulus and continuing 800 ms post-stimulus. During the Limb Pain, the controls and the CD group showed pain empathic responses at frontal N120 and central P300 whereas the CU group didn't show such response. Nevertheless, during the Agent Pain, a late positive potential (LPP) with significant pain effects over frontal, central and parietal areas were observed in the controls and the CU group but not in the CD group. The findings indicated that pain empathy in youth with CU traits, in contrast to CD, could be modulated by social context to a certain degree. The atypical pattern could be ascribed to lack of early emotional sharing but preservation of late emotional regulation under social context.

B48

COILED NON-SNAKE FORMS ARE EFFECTIVE SIGNALS OF THREAT Christine Larson[1], Lorri Kais[1], Vanessa LoBue[2], Molly Barton[1], Elizabeth Steuer[1]; [1]University of Wisconsin-Milwaukee, [2]New York University — Recent work has suggested that simple geometric forms represent a mechanism facilitating rapid detection of potential threat in the environment. A simple downward V shape (similar angry eyebrows) is perceived as aversive, captures attention rapidly, and activates neural circuitry supporting threat detection. Extending this principle, we recently found that coiled wires and hoses were detected just as rapidly in a visual search paradigm as coiled snakes, suggesting that the coiling shape may be a biologically prepared threat cue. In the present study we examined whether the coiling form also recruits threat-related brain regions, further supporting the notion that coiling is also a primitive form evocative of threat. During fMRI scanning participants (N=10) viewed four types of stimuli in a block design: coiled snakes, coiled non-snakes (wires, hoses), uncoiled snakes, and uncoiled non-snakes. Consistent with our hypothesis that coiling would elicit amygdala activation , a Shape (coiled, uncoiled) X Stimulus Type (snakes, hoses/wires) ANOVA revealed a main effect for Shape such that greater amygdala activation was evident for coiled compared to uncoiled stimuli. Furthermore, there was no main effect for Stimulus Type indicating that amygdala activation was not greater for snakes compared to hoses and wires. Finally, the Stimulus Type X Shape interaction was significant and was driven by greater amygdala activation to coiled snakes compared to coiled hoses and wires. Activation for uncoiled snakes was not greater than that for uncoiled hoses/wires. Overall, these data support the hypothesis that the coiling form itself serves as an effective signal of threat.

B49

AMYGDALA'S ROLE IN REFLEXIVE ORIENTING ON EMOTIONAL FACES IN AUTISM SPECTRUM CONDITIONS Dorit Kliemann[1,2], Isabel Dziobek[1,2], Alexander Hatri[1,2], Jürgen Baudewig[1], Hauke R. Heekeren[1,2]; [1]Freie Universität Berlin, Germany, [2]Max-Planck Institute for Human Development, Germany — When processing faces subjects on the autism spectrum (ASC) focus less on the eyes than typically developed controls (NT). A 2-component model (Spezio et al., 2007) suggests that ASC specific gaze patterns on faces might reflect both an avoidance of and a missing orientation to eye contact. On the neural level, reflexive orientation to the eyes in NT is reflected by an increase of amygdala activity (Gamer & Büchel, 2009), whereas findings about amygdala activation and face processing in ASC remain contradictory. We tested whether ASC a) fail to orient to the eyes, accompanied by a decrease of amygdala activity and b) show a tendency to gaze away from the eyes, accompanied by an increase of amygdala activity. Using fMRI and eye tracking, we monitored participants while they performed a facial emotion-discrimination task, in which fearful, happy, and neutral faces were presented for 150ms with fixation starting either at the eyes or the mouth. ASC showed a reduced orientation towards the eyes and a decrease of amygdala activation whereas NT clearly oriented towards the eyes, accompanied by an increase of amygdala activation. When starting fixation on the eyes, ASC showed a strong tendency to gaze away from the eyes. The corresponding greater response in the amygdala is in line with the aversion component. The current results emphasize the specific role of the amygdala in adequately processing social information via mediating orientation towards social cues.

B50

EFFECT OF RIGHT VERSUS LEFT HEMISPHERE LESIONS ON THE ABILITY TO INTERPRET SOCIAL SITUATIONS Juliana Baldo[1], David Wilkins[1], Andrea Zvinakis[1], Nina Dronkers[1,2,3]; [1]VA Northern California Health Care System, [2]University of California, Davis, [3]University of California, San Diego — Previous studies have suggested that the right hemisphere (RH) plays a critical role in our ability to understand the minds of others. Various theories have been used to explain this ability, including the idea that the RH processes "global" information to derive meaning from social contexts. In the current study, we compared 11 RH stroke patients to 11 left hemisphere (LH) stroke patients and normal controls on a cartoon interpretation task that required participants to state what a character in a cartoon was most likely saying/thinking. The test included two types of items: Some cartoons portrayed an unambiguous social situation (e.g., a priest marrying a bride and groom), while other items were more ambiguous (e.g., a sad-looking man with his head down and a woman standing next to him). We hypothesized that RH patients would only show an impairment on the ambiguous items, in which the global context was critical to interpreting the situation. Five independent raters, blind to the aim of the study, scored the participants' responses on a scale from 1-5 (very inappropriate to very appropriate). RH patients were impaired overall on the task relative to controls and also showed reduced performance relative to LH patients (trend). There was no interaction with condition, however, as RH patients' responses were rated as less appropriate on both ambiguous and unambiguous items. These findings provide further support for the role of the RH in social inferencing but also suggest that the degree of ambiguity does not play a significant role.

B51

DRUMMING TOGETHER INCREASES ACTIVITY IN THE CAUDATE AND PROSOCIAL BEHAVIOR - IF DRUMMING COMES EASY Idil Kokal[1], Annerose Engel[1,3], Sebastian Kirschner[4], Christian Keysers[1,2]; [1]BCN NeuroImaging Center, University of Groningen, The Netherlands, [2]The Netherlands Institute for Neuroscience, Amsterdam, The Netherlands, [3]Music Cognition & Action Group, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [4]Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany — Why does chanting together in religious situations, drumming together in a tribe or dancing together in a club make people feel united? Here we investigated the neural correlates of such experiences and its impact on prosocial behavior by letting people drum together. 18 non-musicians learned to drum a simple rhythm - and differed considerably in how easily they acquired the rhythm. Thereafter, their brain activity was measured using functional magnetic resonance imaging (fMRI) while they drummed, in alternating blocks, with two different experimenters: one drummed in- and the other one out-of-synchrony with the participant. On the last run, half the participants drummed continuously with the in- and half with the out-of-synchrony experimenter. Thereafter, this experimenter 'accidentally' dropped eight pencils in front of the participant outside the scanner. Analysis revealed that participants who mastered the rhythm easily prior to scanning showed increased activity in an area involved in social reward, the bilateral caudate, when they drummed in synchrony with another person. Importantly, the amount of activity in this reward area predicted the number of pencils the participants picked up to help the experimenter. We provide the first neuroscientific evidence that evolution has linked joint synchronized musical activity to the reward systems in the caudate, which in turn increases the propensity for prosocial behavior towards synchronized individuals. The instances showing that non-human primates do not spontaneously engage in such joined musical activities suggest that this process is evolutionarily recent and may be specific to humans.

B52

ENHANCED SOMATOSENSORY AND DLPFC EEG POWER TO ERRORS BIASES ERROR ESTIMATIONS AMONG STEREOTYPE THREATENED MINORITIES Chad Forbes[1], Toni Schmader[2], John Allen[3]; [1]National Institutes of Health, [2]University of British Columbia, [3]University of Arizona — Stereotype threat, a situational pressure targets of negative stereotypes experience when they fear their actions may confirm the stereotype, biases stigmatized individuals' attention towards negative feedback early in the information processing stream. Less is known however about how these attentional shifts alter neural processing during the performance, and what ramifications this has on explicit performance perceptions. The present study measured White and minority students' EEG activity while they received error feedback on a task described as an intelligence test. Low resolution brain electromagnetic tomography (LORETA) analyses were conducted and Global EEG power elicited from Brodmann's Area 40 (BA40) and the dorsolateral prefrontal cortex (DLPFC), regions identified as integral to basic, early-stage somatosensory processing and executive function respectively, was extracted via ROI analyses. This provided an on-line neuronal index of early-stage processing and interpretation of error feedback. The relationship between BA40 and DLPFC power and accuracy of students' self-reported error estimates was then examined. Results revealed that increased BA40 power in response to error feedback predicted increased DLPFC power among all subjects. However, increased DLPFC power predicted inaccurate error estimations, where the number of errors made on the supposed intelligence test was overestimated, among stereotype threatened minorities only. DLPFC power partially mediated the relationship between BA40 power and error overestimation. This suggests that stereotype threat engenders enhanced neural activity at early stages of somatosenory processing and later stages associated with sensory interpretation in response to negative feedback. This neural bias in turn has negative ramifications on explicit performance perceptions.

B53

SOCIAL CUES, MENTALIZING AND THE NEURAL PROCESSING OF SPEECH AND GESTURES Benjamin Straube[1,2], Antonia Green[1], Andreas Jansen[1], Anjan Chatterjee[2], Tilo Kircher[1]; [1]Philipps-University Marburg, Germany, [2]The University of Pennsylvania, Philadelphia — Body orientation and eye gaze influence how information is conveyed during face-to-face communication. However, the neural pathways underpinning the comprehension of social cues in everyday interaction are not known. In this study we investigated the influence of addressing vs. non-addressing body orientation on the neural processing of speech accompanied by gestures. While in an fMRI scanner, participants viewed short video clips of an actor speaking sentences with object- (O; e.g. shape) or person-related content (P; e.g. saying goodbye) accompanied by iconic (e.g. circle) or emblematic gestures (e.g. waving), respectively. The actor's body was oriented either toward the participant (frontal, F) or toward a third person (lateral, L) not visible. For frontal vs. lateral actor orientation (F>L), we observed activation of bilateral occipital, inferior frontal, medial frontal, right anterior temporal and left parietal brain regions. Additionally, we observed activity in the occipital and anterior temporal lobes due to an interaction effect between actor orientation and content of the communication (PF>PL)>(OF>OL). Our findings indicate that social cues influence the neural processing of speech- gesture utterances. Mentalizing (the process of inferring the mental state of another individual) could be responsible for these effects. In particular, socially relevant cues seem to activate regions of the anterior temporal lobes if abstract person-related content is communicated by speech and gesture. These new findings illustrate the complexity of interpersonal communication, as our data demonstrate that multisensory information pathways interact at both perceptual and semantic levels.

B54

AN EVENT-RELATED STUDY OF ANIMACY PERCEPTION: TURTLE OR ROBOT Haruaki Fukuda[1], Kazuhiro Ueda[1]; [1]The University of Tokyo — It has been said that we have an ability to distinguish animate things from inanimate things. This ability is called animacy perception and is essential for our social cognition. However, the cortical mechanism underlying animacy perception is controversial. Some studies showed that right Superior Temporal Sulcus (rSTS) was activated in animacy task. Other studies indicated that Mirror System had selectivity for living thing. In this study, we investigated the differences in brain activity between when interacting with an animate thing and when interacting with an artificial thing. We measured Event–Related Potentials (ERPs) for this purpose. In animacy condition, we recorded Electroencephalogram when participants reached a living thing (turtle). In non-animacy condition, they reached an artificial thing (robot). We compared ERPs for the reaching events in animacy condition with those in non-animacy condition. The appearance and motion of the robot were controlled to be the same as the turtle. The ERP difference wave between conditions presented two effects. The first effect was that a positive component was elicited at the beginning of reaching action over the left inferofrontal region only in animacy condition. Later on in reaching action, significantly larger ERPs amplitudes were elicited over the right occipitotemporal region in animacy condition than in non-animacy condition. These differences might be generated in mirror system and rSTS, considering previous neuro-imaging studies and their scalp distributions. These results suggest that both rSTS and Mirror System are involved in animacy perception.

B55

HERITABLE AND NON-HERITABLE BRAIN METABOLISM DURING EXPOSURE TO POTENTIAL THREAT Jonathan Oler[1], Andrew Fox[1], Steven Shelton[1], Terrence Oakes[2], Wendy Shelledy[3], Thomas Dyer[3], John Blangero[3], Jeffrey Rogers[3,4], Richard Davidson[1], Ned Kalin[1]; [1]University of Wisconsin-Madison, [2]Center for Neuroscience and Regenerative Medicine, Washington, D.C., [3]Southwest Foundation for Biomedical Research, [4]Baylor College of Medicine — This study was designed to examine the heritability of the brain's response to acute stress. We measured glucose metabolic activity with FDG-PET in 238 young rhesus monkeys (mean=2.4 years) all belonging to a single-family multigenerational pedigree. We used the no-eye-contact (NEC) variant of the human "intruder" paradigm, thereby posing an ambiguous and relatively mild threat to the animals. Functional and structural brain data were co-registered to a standard rhesus brain template space, and a voxelwise heritability analysis was performed. To estimate the effect of additive genetic variance on observed brain activity the known pedigree relationships and individual phenotype measures were used in variance components analyses with the Sequential Oligogenic Linkage Analysis Routines (SOLAR) software package. To account for potential confounds age, age^2, sex and gray matter probability at each voxel were included in the variance components model as covariates of no interest. The resulting whole-brain heritability data were corrected for multiple comparisons with a False Discovery Rate (FDR; q=0.05). Brain activity during NEC was significantly heritable in bilateral anterior hippocampal regions (right: h^2=0.58, p<0.001; left: h^2=0.61, p<0.001). No significantly heritable clusters were observed in the amygdala. Furthermore, heritability estimates in the dorsal prefrontal cortex (PFC) and posterior cingulate gyrus (PCC) were on the order of 0.9, and were highly significant (p<1.0e-5). These results suggest that threat-related glucose metabolism in anterior hippocampus, the PCC and the PFC reflect inherited neural responses to acute stressors.

B56

GRAY-MATTER PROBABILITY IN THE AMYGDALA PREDICTS ANXIOUS TEMPERAMENT AND IS HERITABLE Andrew Fox[1], Jonathan Oler[1], Steven Shelton[1], Terrence Oakes[2], Wendy Shelledy[3], Thomas Dyer[3], John Blangero[3], Jeffrey Rogers[3,4], Richard Davidson[1], Ned Kalin[1]; [1]University of Wisconsin-

Madison, [2]Center for Neuroscience and Regenerative Medicine, Washington DC, [3]Southwest Foundation for Biomedical Research, [4]Baylor College of Medicine — In humans, childhood anxious temperament is a risk factor for the development of anxiety and depression. In monkeys, functional alterations within the amygdala are associated with the anxious temperament endophenotype. In our previous investigations of the relationship between anxious temperament and brain metabolism we accounted for variability in gray-matter probability (GMP) to ensure that our findings were related to brain function per se. In this work, we complement our previous analyses using a large sample of monkeys (n=238) to specifically investigate the relationship between anxious temperament and brain structure, as measured by GMP at each voxel. In addition, we investigated the heritability of brain structure. Because our subjects were part of a single family pedigree, we were able to investigate the heritability of these structural differences by estimating the additive polygenic component of variation using the Sequential Oligogenetic Linkage Analysis Routines (SOLAR) software package. To account for potential confounds, we co-varied for age, age2 and sex in all statistical analyses. Together these analyses seek to identify regions of the brain where brain structure is related to anxious temperament and is under genetic control. Results demonstrate GMP in the amygdala was correlated with individual differences in anxious temperament ($p<.001$, two-tailed uncorrected; voxel in amygdala $t=3.67$, $p= 0.00015$), and show substantial heritability ($p<.05$, FDR-corrected; peak voxel in amygdala: $h2=.62$, $p=.000065$). These findings suggest that the genetic determinants of structural variation within the amygdala may contribute to the risk to develop affective psychopathology.

B57

TMS EVIDENCE OF A LINK BETWEEN SOCIOCOGNITIVE TRAITS AND LOW-LEVEL MOTOR RESONANCE IN NORMAL INDIVIDUALS

Jean-Francois Lepage[1,2], Sara Tremblay[1,2], Hugo Théoret[1,2]; [1]Université de Montréal, Québec, Canada, [2]Centre de Recherche de l'Hôpital Sainte-Justine, Montréal, Canada — Activity of the primary motor cortex (M1) during action observation is thought to reflect motor-pairing processes hypothesized to play a role in social cognition. The precise time course of M1 activity during action observation remains to be fully determined. Here, we conducted two studies using TMS-induced motor evoked potentials (MEPs) during action observation to determine 1) the time course of M1 excitability during the observation of a simple finger movement; and 2) the relationship between M1 and measures of empathy and autistic traits. In a first study, we used a chronometric approach and administered single TMS pulses at 30ms intervals during the observation of simple finger movements. Results showed enhanced corticospinal excitability occurring between 60 and 90ms after movement onset. In a second study, single TMS pulses were administered at 30, 90 and 150ms after movement onset and participants were asked to complete the Empathy Quotient (EQ) and the Autism Spectrum Quotient (AQ) scales. Correlational analysis revealed a significant link between motor facilitation at 90 ms and the EQ and AQ scores. These results suggest that corticospinal excitability modulation seen at M1 during action observation is the result of a rapid automatic process, which may be related to social functioning.

B58

SEGREGATING THEORY OF MIND FROM ACTION SIMULATION

Marc Thioux[1], Linda Geerligs[1], Luca Nanetti[1], Christian Keysers[1]; [1]University of Groningen, The Netherlands — Mirror neurons are known to encode the immediate goal of observed actions (the intention in action). We used fMRI to test the hypothesis that the same system could also support the comprehension of higher levels of intentions and mental states. Subjects viewed short movies of actors grasping a big or a small ball inside a box. In one condition, the subjects had to decide whether the actor was going to grasp the big or the small ball. In the other condition, they had to judge whether the actor was sure about which ball to pick. Only the torso and the hand of the actors were visible in the movies. Relative to baseline the two conditions were associated with increased activity in the parietal and premotor cortex, suggesting that participants simulated the observed action within the mirror neuron system. Contrasting the two main conditions directly, we found increased activity in the mirror neuron system when the participants had to pay attention to the immediate goal of the action (big or small ball). The reverse contrast however showed that activity increased in the temporo-parietal junction when the participants were requested to judge whether the actor was sure about which ball to pick or not. Our results demonstrate that shifting attention from the immediate goal to the mental states of others shifts neuronal activity from the mirror neuron system to the temporo-parietal junction.

B59

MAINTAINING OPTIMISM IN THE FACE OF REALITY: A LEARNING BIAS

Christoph Korn[1,2], Ray Dolan[1], Tali Sharot[1]; [1]Wellcome Trust Centre for Neuroimaging, University College London, [2]Berlin School of Mind and Brain, Free University Berlin — Humans express a pervasive optimism bias. They tend to make overly positive predictions about the future, which are often inaccurate. How do people maintain unrealistic positive views, while frequently encountering information that challenges those optimistic beliefs? Here, we reveal a novel learning bias supporting optimism that is mediated by differential processing of negative and positive information in the anterior cingulate cortex (ACC). We collected functional magnetic resonance imaging (fMRI) data while participants estimated the likelihood of experiencing 80 different negative life events (e.g. cancer, divorce, robbery). After each trial participants were presented with the average probability of that event occurring to a person in the developed world. In a second session they were again asked to estimate the likelihoods, so we could to assess whether they had updated their expectations. Results show that participants selectively learned from information that enforced optimism. When subjects had over-estimated the probabilities of a negative event (i.e. gave a pessimistic estimate and received positive information) they were more likely to update their expectations than when they under-estimated the probability (i.e. gave overly optimistic estimates and received negative information). fMRI data revealed an error signal in the ACC that coded the difference between participants' estimate and the feedback they received. Strikingly, this signal was larger when the participant received positive information relative to negative information. The study uncovers a neural mechanism supporting differential processing of wanted and unwanted information about the future, which leads to unrealistic optimism.

B60

MORAL DECISION-MAKING...THE SECOND TIME AROUND

Jana Schaich Borg[1], Scott Grafton[2], Walter Sinnott-Armstrong[3]; [1]Stanford University, [2]University of California, Santa Barbara, [3]Dartmouth College — Much has been learned about how people make complex moral judgments the first time they encounter difficult moral scenarios. However, judgments about controversial moral issues (such as euthanasia or stem-cell research) are often easier to make after the issues have been previously encountered, even if the judgments one makes remain emotional or controversial. Here we investigate whether responses to well-characterized moral dilemmas change over time. 51 subjects were given twice our previously-published questionnaire of 36 moral and non-moral scenarios that controlled for the amount of harm (consequences), commission vs. omission of action, and intentional vs. unintentional harm: once when the scenarios were brand new and again at least two weeks later. Participants responded to scenarios much more quickly the second time they encountered them, and also more consistently. Moreover, participants judged more moral acts to be wrong (and were less willing to perform them) and judged more non-moral acts to be not wrong (and were more willing to perform them) the second time they encountered them, especially if an act required an overt action to arrive at equivalent amounts of harm. fMRI results from thirteen subjects who responded to the moral questionnaire twice while being scanned support the hypothesis that different cognitive processes are evoked by moral dilemmas that have been previously considered than by moral dilemmas that have never been considered. These results may have implications for our understanding of how humans process difficult moral issues on a daily basis, as opposed to in isolated crisis situations.

B61

SENSORY AND HEDONIC CUES SHOW ASSIMILATION EFFECTS FOR LIKED, BUT NOT DISLIKED YOGHURT STIMULI Johanna Kuenzel[1,2], Wael El Deredy[2], Isabelle Blanchette[2], Elizabeth H. Zandstra[1], Anna Thomas[1]; [1]Unilever R&D Vlaardingen, [2]University of Manchester — Expectations help us to predict the world and to deal with the uncertainties of daily life. This experiment studied the effect of reward expectations evoked by sub- and supraliminal cues on liking of yoghurts. As cues, different unfamiliar symbols were used. N=39 participants first learned to associate one cue with a highly sweet yoghurt and one with a mildly sweet yoghurt (liked yoghurts). The same was done with two other cues for mildly/highly salty yoghurts (disliked yoghurts). Half of the participants learned to associate a cue with liking of the yoghurt, i.e. hedonic cues, the other half with how sweet/salty they were, i.e. sensory cues. In every trial (40 trials), a cue was shown for 20 or 500msec and participants then tasted a yoghurt. The drink-cue combination was either congruent (e.g. high-sweet cue, high-sweet yoghurt), incongruent (high-sweet cue, mild-sweet yoghurt), or mildly incongruent (high-sweet cue, medium-sweet yoghurt). Results showed that hedonic and sensory cues equally influenced liking. For sweet/liked yoghurts we showed clear assimilation effects: liking followed the direction of the cue. This was found for supraliminal (500msec) but not for subliminal (20msec) cue presentations. For salty yoghurts, no effects of cues were found. A probable reason is that the yoghurts were not disliked enough. To our knowledge, this study is the first to address how different cues influence liking of a product. This provides insights on how expectations shape liking, about properties of expectations necessary to evoke these effects and helps in the interpretation of behavioural and neuroscience studies.

B62

HUMOR PROCESSING IN INDIVIDUALS WITH ASPERGER'S SYNDROME Andrea Samson[1], Karsten Müller[2], Michael Hegenloh[3], Oswald Huber[1], Maximilian Reiser[3], Thomas Meindl[3], Kristina Hennig-Fast[3]; [1]University of Fribourg, Switzerland, [2]Max-Planck-Institute of Cognitive Neuroscience, Leipzig, Germany, [3]Ludwig-Maximilians-University, Munich, Germany — The present study aims to investigate with functional Magnetic Resonance Imaging (fMRI) humor processing and appreciation in individuals with Asperger's syndrome (AS) and a healthy control group. 90 humorous cartoons were contrasted to a control condition, consisting of cartoon-like pictures with an irresolvable incongruity. 14 individuals with AS and 14 healthy controls were investigated in a 3T fMRI scanner. The inferior frontal gyrus and the temporo-parietal junction (TPJ) were activated in humor processing and appreciation in contrast to the control condition, replicating results from previous fMRI studies on humor. Furthermore, the insula was activated which was discussed by Watson et al. (2006) in relation to humor. The analysis of the comprehension ratings showed that individuals with AS had more difficulty to understand the punch lines. However, if they understood the punch line they did not differ from the control group regarding the funniness ratings. We expect to find in individuals with AS less activation in so-called "mind reading" and "mentalizing" areas such as the TPJ and anterior medial prefrontal cortex. At the CNS, the analysis of fMRI data on the differences between individuals with AS and the healthy control group will be presented as well.

B63

MENTALIZATION IMPAIRMENTS IN FIRST-EPISODE PSYCHOSIS Amelie M. Achim[1,2], Rosalie Ouellet[1,2], Marc-André Roy[1,2], Philip Jackson[1,2,3]; [1]Centre de Recherche Université Laval Robert-Giffard (CRULRG), [2]Université Laval, [3]CIRRIS — Although several studies have highlighted mentalization (also known as Theory of Mind) impairments in people with schizophrenia, very few studies have assessed this aspect of social cognition in young adults with a first-episode of psychosis (FEP). For this study, we recruited 34 FEP patients and 34 matched control subjects who performed a mentalization task as well as a non-social reasoning task. In addition, other aspects of social cognition such as social perception and social knowledge were also assessed. The mentalizing task showed the greatest effect size, with an effect size d = .68, whereas the social perception and social knowledge tasks showed effect sizes in the low range (d=.27 and d=.25, respectively) and failed to reach significance. In addition, a significant impairment was detected for the non-social reasoning task (d=.50), so we also compared the two groups for the mentalizing task using the non-social reasoning scores as a covariate, and the between group difference for the mentalizing task remained significant. This study suggests that mentalizing is particularly affected in FEP, although the specific cognitive mechanisms that are at play remain to be outlined.

Executive Processes: Development & Aging

B64

PREDICTING EFFORTFUL CONTROL FROM ATTENTION AND EMOTIONALITY IN INFANCY Alexandra Ursache[1], Clancy Blair[1]; [1]New York University — The Rothbart-Posner model of temperament posits that young children who are better able to use executive attention to regulate negative affect will exhibit higher effortful control. The goal of the current investigation was to more specifically examine developmental trajectories of attention and negative affect as predictors of early effortful control. The sample included approximately 1,100 children from predominantly low-income, rural communities participating in a large longitudinal study. Data collectors in the home rated infants' attention and irritability at 7, 15, and 24 months of age. At 24mos, children completed two measures of effort control: a delay task and a working memory task. We found that attention was significantly related to performance on the delay task at all ages, r =.07, .08, .17, all p<.05, and to performance on the working memory task at 15mos and 24mos, r =.10 and r =.26, both p<.001. For the effortful control tasks, the relationship with attention increased significantly with age. Ratings of irritability, however, were not significantly related to performance on the tasks until 24mos. Additionally, irritability and attention were significantly related and stable from 7mos to 15mos, r=-.59, p<.001, but the relation increased at 24mos, r=-.74, p<.001. Consistent with the Rothbart-Posner model, these results suggest that while attention is a good predictor of effortful control from infancy, negative emotionality does not emerge as a predictor of effortful control until the toddler period at which time children are expected to use attention to regulate negative affect.

B65

DEVELOPMENTAL TRAJECTORIES OF COGNITIVE CONTROL IN ADOLESCENCE: AN FMRI INVESTIGATION OF THE STROOP TASK Jessica Andrews-Hanna[1], Kristen L. Mackiewicz[1], Luka Ruzic[1], Laurence Steinberg[2], Eric Claus[3], Elizabeth E. Cauffman[2], Jennifer L. Wollard[4], Sandra Graham[5], Marie T. Banich[1]; [1]University of Colorado Boulder, [2]Temple University, [3]Mind Research Network, [4]Georgetown University, [5]University of California Los Angeles — Although adolescence is often behaviorally characterized by poor cognitive control, impulsivity, and elevated emotional reactivity, the neural underpinnings of these behavioral phenotypes remain largely unknown. The present study sought to investigate developmental functional changes in cognitive control and interference resolution while 66 participants between the ages of 14 and 25 performed a variant of the Stroop Color-Word task (Stroop, 1935). Four separate age groups (14-15 year olds, N = 16; 16-17 year olds, N = 17; 18-21 year olds, N = 15; 22-25 year olds, N = 18) completed a hybrid block/event-related functional MRI design providing means to investigate transient and sustained fMRI patterns of cognitive control. Results revealed minimal differences in behavioral interference (marked by increases in RT during incongruent compared to neutral stimuli) across groups, accompanied by drastically different patterns of activation. Activity in regions comprising a frontoparietal control network increased across age for INCONGRUENT compared to CONGRUENT or NEUTRAL blocks, particularly between the two youngest groups. Event-related results demonstrated similar age patterns. Additionally, behavioral interference effects correlated positively with Stroop-related patterns of activation. Interestingly, group changes were also observed within the so-called "default network." The 16-17 year olds exhibited stronger activation of the default network during fixation blocks, with increased contributions of two regions involved in emotion: the ventromedial prefrontal cortex and the insula. In summary, adolescence appears to be marked by progressive functional maturation of sustained and transient processes associated with cognitive control and relative overactivation of limbic regions during rest.

B66

EMOTIONAL FEEDBACK AFFECTS AGE-RELATED DECLINES IN COGNITIVE SET SHIFTING Marissa A. Gorlick[1], Brian D. Glass[1], Tanya Chotibut[1], W. Todd Maddox[1]; [1]University of Texas, Austin — Normal aging is associated with declines in many aspects of executive function that co-occur with several structural and functional changes (Raz, 2000). One aspect of executive function that is especially susceptible to normal aging is cognitive set shifting. For example, older adults perseverate more than younger adults in the Wisconsin Card Sort Task (WCST; Rhodes, 2004). Other research indicates that as we approach the end of life, regulation of emotional states becomes more important than other types of goals (Carstensen, 2006). These shifts in motivation lead to increased attention to positive emotional experiences and/or decreased negative emotional experiences (Mather & Carstensen, 2005). The present study merges these two lines of work and tests the hypothesis that emotional feedback might attenuate age related cognitive set shifting deficits. We examined the performance of healthy older (aged 60-90) and younger adults (aged 18-35) in a set shifting task analog of the WCST. Four versions of the task were examined that differed only in the nature of the feedback and were constructed from a factorial combination of feedback type (logical: points vs. emotional: faces) and feedback valence (positive vs. negative). Preliminary results suggest that emotional feedback does attenuate set shifting deficits in older adults. Older adults are faster at initial concept learning in emotional feedback conditions, especially with positive emotions. In addition, older adults are quicker to abandon a previous valid rule in favor of a new rule in emotional feedback conditions. Implications of this work in a socioemotional approach to learning are discussed.

B67

LIFESPAN DIFFERENCES IN ELECTROPHYSIOLOGICAL CORRELATES OF EARLY MONITORING AND LATE EVALUATIVE PROCESSES OF CHOICE-OUTCOME CONTINGENCY: DIFFERENTIAL ROLES OF FEEDBACK-RELATED NEGATIVITY AND FEEDBACK-RELATED POSITIVITY Dorothea Haemmerer[1], Guido Biele[2], Marios Philiastides[1], Sascha Schroeder[1], Viktor Mueller[1], Ulman Lindenberger[1], Shu-Chen Li[1]; [1]Max Planck Institute for Human Development, Germany, [2]Freie Universität Berlin, Germany — The aim of the study was to investigate lifespan differences in ERPs of early monitoring (N2 or feedback-related negativity) and late evaluative (P3 or feedback-related positivity) processes during reinforcement learning. Previous evidence suggests that the P3 amplitude to feedback is larger when the perceived choice-outcome contingency is low (e.g., Tueting, 1970, Eppinger, et al. 2008). By fitting a reinforcement learning model (cf. Krugel et al. 2009) to the behavioural data at the individual level, we investigated whether prediction errors (PEs) are differentially related to the two feedback-related ERPs. Given that children and older adults learn less from performance feedback (Eppinger et al. 2008), we expected lesser effects of PEs in these two groups. We tested 166 participants (39 children, 44 adolescents, 42 younger adults, and 41 older adults) on a probabilistic reinforcement learning task (cf. Frank et al., 2004) and recorded EEG from 64 electrodes. We found a reliable positive association between PEs and the P3 amplitude following gains. Relations between PEs and N2 did not differ reliably from zero, and differed reliably from relations between PEs and P3, indicating that outcome evaluative processes are more strongly reflected in the P3 than in the N2 component. Furthermore, the relation between PEs and P3 was statistically significant in adolescents and younger adults (P3 increase of 5.15µV and 3.51µV per SD PE, respectively) but not in children or older adults (2.92µV increase and 1.22µV increase, respectively), indicating lifespan age differences in evaluative processes of outcome monitoring and their EEG correlates.

B68

BRAIN AND COGNITIVE CHANGES AFTER PHYSICAL TRAINING IN COGNITIVELY NORMAL SENIORS Elizabeth Kanter Bartz[1], Molly Keebler[1], Claire Gardner[1], Raksha Anand[1], Jinsoo Uh[2], Hanzhang Lu[2], Joseph Cleaver[3], Kenneth Cooper[3], Sandra Bond Chapman[1], John Hart Jr.[1,2]; [1]University Of Texas at Dallas, [2]University of Texas Southwestern, [3]The Cooper Institute — Adults 60 and over represent one of the fastest growing segments of our society. It is anticipated that this cognitively vulnerable group could experience a high incidence of cognitive decline with aging. Significant potential exists to modify the structure and function of the aging human brain with physical activity. Preliminary evidence highlights the potential of physical training to modify and strengthen brain and cognitive function in seniors. In this study, sedentary, cognitively-normal seniors between ages 60 and 70 years were recruited for the study and randomized into 2 groups: a physical-trained group and a wait-listed control group. Participants were neuropsychologically screened to insure they were cognitively normal. Prior to intervention, participants' baseline cognitive functions, fitness measures and structural/physiological Magnetic Resonance Imaging (MRI) measures were obtained. In particular, Magnetization-Prepared Rapid Gradient- Echo (MPRAGE) and Arterial Spin Labeling (ASL) sequences were collected. Participants then underwent 12 weeks of aerobic physical training (exercise group) or maintenance of current level of activity (wait-listed group) with the same assessment as baseline at midpoint and endpoint. Brain imaging will measure changes in relative cerebral blood flow, global and regional brain volume with a particular focus on changes to frontal regions and hippocampus. We have found increased relative blood flow to the hippocampus after 12 weeks of exercise and a correlated 13% improvement in new learning tasks. Overall physical exercise has the potential to improve cognitive function, in particular new learning with an associated increase in medial temporal relative blood flow, after 12 weeks of physical exercise.

B69

DECREASED INTER-REGIONAL RELATIONSHIPS AMONG D1 RECEPTORS IN AGING Anna Rieckmann[1], Sari Karlsson[1], Per Karlsson[1], Yvonne Brehmer[1], Lars Farde[1], Lars Nyberg[2], Lars Bäckman[1]; [1]Karolinska Institutet, [2]Umeå University — Age-related losses in dopamine receptor densities have emerged as a powerful mediator of age-related cognitive decline. However, most age-comparative molecular imaging studies have focused exclusively on striatal D2 receptor densities. Much less is known about changes in the D1 receptor with aging, despite recent findings that striatal and extrastriatal D1 receptors play an important role in executive functioning, inhibition, and working memory. We used Positron Emission Tomography and SCH23390 to quantify D1 receptor binding in 20 younger (20-30 years) and 20 older (65-75 years) healthy adults. Results showed age-related decreases in D1 receptor densities in striatal, limbic, and neocortical regions. Moreover, receptor densities in subdivisions of the striatum (associative, ventral, and sensorimotor) were strongly correlated with each other and with receptor densities in frontal and limbic areas in younger, but not in older, adults. This may indicate that the age-related loss of D1 receptors is not mediated by a global mechanism. We discuss these results in terms of their implications for understanding age-related cognitive decline.

B70

THE EFFECTS OF CHRONIC DOPAMINE AND SEROTONIN ANTAGONISM ON COGNITIVE DEVELOPMENT IN MONKEYS Dorothy J. Mandell[1,2], Gene P. Sackett[2]; [1]University of Amsterdam, [2]University of Washington, Washington National Primate Research Center — It has been proposed that developmental changes in dopamine (DA) is a neurobiological mechanism contributing to the development of executive functioning skills that involving reward processing. Developmental changes in frontal (Lambe, et al. 2000) and striatal (Haycock, et al., 2003) DA biomarkers have been documented between birth and late adolescents. However, it is unclear how changes in DA concentrations are related to changes in behavior. We assessed the effects of chronically antagonizing the DA/5HT system (with risperidone) or the 5HT system (with quetiapine) on cognitive development. Subjects were 40 mother-reared juvenile macaques (M. nemestrina) randomly assigned to a placebo, risperidone or quetiapine drug group. Animals began cognitive testing at 260 days of age (SD=16) and were followed for 64 weeks. Monkeys were tested on a variety of age-appropriate cognitive tasks during 4 16-week phases: 1) pre-drug, 2) low-dose, 3) high-dose, and 4) off-drug. The cognitive results from Learning Set (LS; Harlow, 1949) and Nonmatch to Sample (NMTS) are presented here. All animals significantly improved on LS over the course of testing. A significant drug by phase interaction was found ($p<.02$). Animals did not significantly differ at baseline. During the low-dose phase, the risperidone group outperformed the placebo group ($p<.05$) and remained the highest performing group through the two drug phases. During the off-drug phase, the performance of these animals dropped significantly ($p<.02$). In contrast, no significant drug interactions were found with NMTS performance. These data provide evidence that chronic disruption of DA affects the development of reward-directed behavior.

B71

INHIBITION OF RESPONSES IN YOUNG MONOLINGUAL AND BILINGUAL CHILDREN: EVIDENCE FROM ERP Raluca Barac[1], Sylvain Moreno[1], Ellen Bialystok[1,2]; [1]York University, [2]Rotman Research Institute & University of Toronto — Previous behavioral research has reported advantages for bilingual children relative to comparable monolinguals in aspects of nonverbal executive functioning such as inhibitory control (Bialystok & Martin, 2004; Carlson & Meltzoff, 2008), and switching (Barac & Bialystok, 2009). These findings have been attributed to their need to manage attention to two languages in order to switch between them and inhibit interference from the inactive language. This management of attention is handled by the executive function system and its frequent use for this purpose enhances these processes for bilinguals. To date, in children this has been examined exclusively in behavioral studies. Therefore it is not known whether the experience of speaking two languages also results in changes apparent in children at the brain level. In the current study we recorded ERPs in 32 5-year-old children (16 English-speaking monolinguals, 16 bilinguals) as they performed a standard visual Go/No-go task. Children were matched in terms of age and general intelligence as measured by vocabulary and block design subtests of the Wechsler Preschool and Primary Scale of Intelligence - III. Our results showed that bilingual children had higher N2 amplitude than monolinguals for the No-go trials, whereas the performance on the Go trials was similar for the two groups. The N2 component is related to conflict detection and response inhibition, so the greater amplitude for the bilingual children is interpreted as greater sensitivity and responsiveness to conflict. These results are used to interpret evidence for better cognitive control by bilinguals in previous behavioral research.

B72

IMPROVING CORTICAL EFFICIENCY WITH AGE: AN ELECTROENCEPHALOGRAPHY (EEG) STUDY OF CORTICAL ACTIVITY DURING RESPONSE INHIBITION Zhong-Xu Liu[1], Marc D. Lewis[1]; [1]University of Toronto — Response inhibition, one aspect of executive function, plays an important role in children's cognitive development. It has been proposed that brain maturation, especially cortical efficiency improvement, may underlie the development of inhibitory control. However, previous studies using EEG and functional magnetic resonance imaging have shown inconsistent results: Some studies find cortical activity increases with age but others find the opposite. The present study was designed to provide more data on this issue by focusing on EEG power during response inhibition. EEG data were collected from 42 normally developing children (age: 8-18 years) while they performed a go/no-go task. We examined EEG power in alpha (8-12Hz) and theta (4-7Hz) frequency bands during no-go trials. Hierarchical linear regressions were employed to test the role of cortical activation underlying developmental effects. Results showed that 1) behavioral performance improved with age, 2) baseline (-250ms – 0ms) power at both frequency bands decreased with age, and 3) theta power during the response inhibition window (200 – 400ms post-stimulus) increased with age. Also, baseline alpha and theta power were negatively, and theta power during inhibition positively, correlated with behavioral performance. Most important, when the effects of these brain measures on behavioral performance were controlled, age effects on performance became nonsignificant. Therefore, these findings indicate that, as children age, the cortex becomes less activated before an inhibitory task but more activated during the task, suggesting a more efficient allocation of neural resources. This provides support for a model of cortical development highlighting increasing efficiency.

B73

DEVELOPMENTAL CHANGES IN CONNECTIVITY ASSOCIATED WITH INHIBITORY CONTROL Kai Hwang[1], Katerina Velanova[1], Robert Terwilliger[1], Beatriz Luna[1]; [1]University of Pittsburgh — The ability to voluntarily suppress responses to task irrelevant stimuli is crucial to cognitive control. Response inhibition has been shown to improve from childhood through young adulthood. Prior developmental fMRI studies of response inhibition have found changes of brain activity in a distributed network. However the developmental changes in connectivity supporting the response inhibition circuitry is not well studied. In the current study, we measured connectivity between brain regions associated with inhibitory control with functional connectivity and granger causality. We then characterized the developmental changes of this connectivity profile. We recruited 78 participants (27 adults aged 18-7, 25 adolescents aged 13-17 years, and 26 children aged 8-12 years) for our FMRI study. Subjects were asked to perform the antisaccade (AS) task. Connectivity analyses were applied to the preprocessed time series extracted from oculomotor and cognitive control regions recruited by the AS task. We found that frontal cognitive control regions (right DLPFC, right IFG, bilateral insula, ACC) were connected to down-stream oculomotor regions (FEF, IPS, thalamus, basal ganglia and superior colliculus) in adolescents and adults, more than children. Granger causality analysis revealed that these connections were mostly top-down, with frontal regions influencing parietal and subcortical regions. Developmentally, connectivity strength increased with age from frontal to parietal and subcortial regions. In contrast short-range connectivity strength within the parietal cortex decreased with age. Our developmental results support the hypothesis that developmental improvements in inhibitory control are supported by enhancing top-down connectivity from the prefrontal cortex to parietal and subcortical regions.

B74

PREDICTORS OF INHIBITORY CONTROL GROWTH IN PRESCHOOL CHILDREN: A LONGITUDINAL STUDY Sandra A. Wiebe[1], Kimberly Andrews Espy[2], Tiffany Sheffield[2]; [1]University of Alberta, [2]University of Nebraska-Lincoln — The preschool years are an important time for the development of executive control, related to the continued maturation of networks involving prefrontal cortex. This study examined the development of inhibitory control, and relations between growth and child demographic and temperament characteristics. The sample included 394 preschool children (194 girls, 200 boys), enrolled at 3, 3.75, 4.5, or 5.25 years in a cohort-sequential design, and followed longitudinally every 9 months through age 5.25. Children completed a preschool go/no-go task, and were instructed to press a button whenever a fish appeared on the computer screen (75% of trials), but withhold the button-press when a shark appeared (25% of trials). We used growth curve modeling to analyze accuracy on go and no-go trials as well as reaction times for go trials, and then examined the relations between growth parameters and covariates including maternal ratings of child temperament and behavior problems, maternal education (as an index of SES), and child sex. Children with better effortful control were more accurate on no-go trials, but less accurate on go trials. Children with fewer attention problems also were more accurate on no-go trials. Higher maternal education was associated with more accurate go performance and faster improvement in response times on go trials. Girls were more accurate on no-go trials, whereas boys responded more quickly and accurately on go trials. Results extend previous findings of sex and SES differences in preschool executive control, and suggest that go/no-go performance is meaningfully related to everyday behavioral regulation.

B75

IMPROVEMENT IN MIDLIFE COGNITION: IMPLICATIONS FOR COGNITIVE AND BRAIN AGING Sherry Willis[1], Elizabeth Aylward[2], Paul Borghesani[1], Tara Madhyastha[1]; [1]University of Washington, [2]Seattle Children's Research Institute — Longitudinal studies report normative patterns of stability in cognition during midlife. However, prospective dementia studies report preclinical changes in cognition occurring as early as midlife. In this study we examine the group differences in brain volume and functioning for individuals exhibiting either cognitive decline or cognitive gain in midlife. Seattle Longitudinal Study subjects were assessed on an extensive psychometric ability battery at multiple occasions in midlife (age 43 – 63). Subjects' midlife trajectories on three abilities (executive functioning, verbal memory, psychomotor speed) were characterized as indicating reliable decline, gain, or stability. While midlife trajectories were stable for the majority of subjects, approximately ten to fifteen percent of subjects showed reliable decline or reliable gain. Decliners and gainers did not differ in age or education. Structural MRI scans and DTI analyses were conducted on subjects who declined or gained cognitively in midlife and who were currently in midlife or old age. Analyses indicated significant differences in brain volume for those showing midlife decline vs gain on episodic memory and executive functioning.

B76

FMRI OF AN N-BACK WORKING MEMORY TASK IN CHILDREN AND ADULTS Yao (Sarah) Lin[1,2], Lauren Dade[2,3], Marie Arsalidou[2], Elizabeth J. Donner[2], Margot J. Taylor[1,2]; [1]University of Toronto, St. George, [2]Hospital for Sick Children, [3]Bloorview Kids Rehabilitation — Although working memory (WM) has been extensively studied in adults using fMRI, little is known about how this capacity develops in the human brain. Here, we assessed the neural correlates of WM in 36 healthy children, aged 6-16 years, and 19 adults, aged 19-34 years, using an n-back block-design fMRI paradigm. Colorful abstract patterns were presented in three conditions that demanded varying WM maintenance. In 1- and 2-back conditions, participants indicated when the current stimulus matched the one presented n trials previously, where n=1 or n=2. In the 0-back vigilance condition, participants responded to a solid blue square. Children were divided into 4 age groups for analysis. Group images were analyzed using a random effects analysis of variance. Three contrasts (1>0, 2>0, 2>1) were computed for the whole brain to identify task-specific activations. Behavioral results indicated adults were more accurate and were quicker to respond than children across all conditions, with the largest difference at the highest load. Although activations in bilateral inferior frontal, middle frontal and cingulate gyri, and parietal cortex were generally similar in adults and children, children demonstrated less focal activity in these regions. Additionally, while adults responded to higher WM loads by recruiting frontal regions, young children did not exhibit increasing frontal activation. Furthermore, correlations were observed between frontal activity and behavioral profiles as a function of age. These findings revealed a developmental trajectory of WM in which activations increase as a function of greater WM load and become more focal with age.

B77

QUANTIFIER COMPREHENSION IN CORTICOBASAL SYNDROME AND FRONTOTEMPORAL DEGENERATION Brianna Morgan[1], Rachel G. Gross[1], Corey McMillan[1], Ashley Boller[1], Murray Grossman[1]; [1]University of Pennsylvania — This study contrasted number-based and majority quantifiers involving number knowledge with logical quantifiers that do not depend on numbers in corticobasal syndrome (CBS) and frontotemporal degeneration (bvFTD). We studied 6 CBS, 10 bvFTD and 11 matched controls. Participants evaluated the truth value of a statement describing a picture. Four sentence types with quantifiers and a factual control without a quantifier were created to correctly described each of 20 pictures depicting familiar objects (e.g. cups on a table, books on a shelf). An equal number of false sentences were created, resulting in 200 randomly-ordered, picture-sentence stimuli. The four experimental sentences included: Precise—naming an exact number (e.g. "there are 3 cups on the table"); number-based—"…at least two…"; majority—"…more than half…"; logical—"…some…"; and control—"there are books…". Sentences contained only small, single-digit numbers and were matched for length with adjectives. CBS showed selective deficits for stimuli involving number knowledge—Precise, Number-Based and Majority—compared to controls (p=0.05), but equaled controls for logical quantifiers and control statements. bvFTD were selectively impaired for logical quantifiers and majority quantifiers (p=0.05), but equaled controls for number-based, precise and control statements. Results support previous findings in CBS, showing comprehension difficulty for quantifier statements that depend on number knowledge. bvFTD showed deficits for majority quantifiers that entail working memory. Moreover, bvFTD were impaired with logical quantifiers. This is consistent with their social judgment deficit, and our "social executor" model that emphasizes resource limitations in adapting social/emotional knowledge to real-world settings.

B78

BRAIN OSCILLATORY 1-40 HZ FREQUENCY RESPONSES DURING AN AUDITORY WORKING MEMORY TASK IN 6-, 11- AND 14-YEAR-OLD CHILDREN Anna-Mari Andersson[1], Aleksander Alafuzoff[1], Heini Heikkilä[1], Venla Pehunen[1], Tero Hakala[1], Nina Sajaniemi[1], Elina Kontu[1], Meri Reunanen[1], Tarja Puhtimäki[1], Sirpa Ranto[1], Mari Nislin[1], Christina M. Krause[1]; [1]Helsinki University — The development of the cognition-related brain oscillatory response system in childhood is yet poorly understood. Current study investigated the relationships between the development of memory functions and brain oscillatory EEG responses during an auditory memory task (encoding and recognition). Altogether 49 healthy children from three different age groups (mean ages 6, 11 and 14 years; n=16, n=17 and n=16, respectively) were included in the study. Brain oscillatory responses of the 1-40 Hz EEG frequencies during the performance of an auditory memory task were assessed. On the behavioural level, in the memory task, the 11- and 14-year-old children performed equally well, while the 6-year-old children performed statistically significantly poorer. In the EEG alpha frequency range (~8-12Hz), both during encoding and recognition, greater magnitude brain oscillatory responses were witnessed in the 11- and 14-year-old children as compared to those of the 6-year-old children. Brain oscillatory responses during memory processing - especially in the EEG alpha frequency range - differentiated the 6-year-old children from the 11- and 14-year-old children. This observation might reflect the difference in cognitive developmental stage.

B79

NEURAL UNDERPINNINGS OF EXECUTIVE FUNCTION DEVELOPMENT IN ADOLESCENCE: A LONGITUDINAL INVESTIGATION Monica Luciana[1], Paul Collins[1], Ryan Muetzel[1], Jim Porter[1], Kelvin Lim[1]; [1]University of Minnesota — Brain development continues throughout adolescence with post-pubertal nonlinear declines in gray matter (GM) and linear increments in white matter (WM) volumes that regionally vary. Diffusion tensor imaging (DTI) suggests increments in WM's directional organization. Executive functions (EFs) improve. Whether age-related changes in structural maturation underlie EF improvements is the focus of this analysis. Adolescents (n=165, ages 9-23) completed structural MRI/DTI scans, acquired on a 3-tesla Siemens Trio Scanner. EFs were assessed through a comprehensive battery. Self-reported personality characteristics were measured. Participants repeated the full battery two years later. We observe widespread declines in GM/cortical thickness (r's= .45 to .65) with more subtle changes in WM. Indices of WM microstructure (fractional anisotropy) show age-related increases (r's=.2 to .3); the effect size is similar when derived from region-of-interest versus probabilistic tractography approaches. Age-related improvements in working memory, inhibition, and planning (r's = .2 to .7) are evident; performance asymptotes around age 17. Motivated decision-making improves into the late teens. Cross-sectional analyses have described structural networks that support performance on motor (Muetzel et al., 2008), delay discounting (Olson et al., 2009), planning (Luciana et al., 2007), and verbal fluency (Porter et al., 2009) measures. This analysis extends those findings by presenting composite scores reflecting major domains of EF derived from longitudinal data. Regression analyses will be implemented to assess which aspects of neural maturation contribute to longitudinal changes in EF domains with the goal of dissociating structural networks that support 'cold' versus 'hot' cognition. Findings will inform our understanding of adolescents' EF development.

B81

EVENT-RELATED EEG OSCILLATIONS IN HIGH-PERFORMING YOUNG AND ELDERLY INDIVIDUALS DURING COGNITIVE FLEXIBILITY TASKS Bruno Kopp[1,2], Jürgen Howe[3], Karl Wessel[1,2]; [1]Cognitive Neurology, University of Technology Carolo-Wilhelmina Braunschweig, [2]Braunschweig Hospital, [3]University of Technology Carolo-Wilhelmina Braunschweig — We conducted a study of normal brain aging that was based upon event-related brain potentials (ERPs) and time-frequency analysis of event-related EEG biosignals. Forty participants (twenty-four young, mean age 22 years; sixteen elderly, mean age 70 years) took part in two tasks that were designed to challenge cognitive flexibility. Time-frequency analysis of event-related EEG oscillations rested on complex Morlet wavelet transformations in the theta-, alpha- und beta-frequency bands. Elderly participants had slower RTs than young participants, whereas error rates did not differ between the two age groups. Elderly participants showed reduced auditory N1 and P2 amplitudes and a 'frontal shift' of the P3b. Time-frequency analysis of brain oscillations revealed two novel findings: 1. The elders showed less pronounced stimulus-induced alpha-desynchronization at posterior electrodes. 2. The elders showed more pronounced beta-desynchronization at central electrodes in response to imperative stimuli. Cortical beta rhythms might indicate the integrity of frontal-subcortical loops and their dopaminergic regulation.

B82

A NEUROIMAGING INVESTIGATION OF THE ASSOCIATION BETWEEN AEROBIC FITNESS, HIPPOCAMPAL VOLUME AND MEMORY PERFORMANCE IN PREADOLESCENT CHILDREN Laura Chaddock[1], Kirk I. Erickson[2], Ruchika Shaurya Prakash[3], Jennifer S. Kim[1], Michelle W. Voss[1], Matt VanPatter[1], Matthew B. Pontifex[1], Lauren B. Raine[1], Alex Konkel[1], Charles H. Hillman[1], Neal J. Cohen[1], Arthur F. Kramer[1]; [1]University of Illinois at Urbana-Champaign, [2]University of Pittsburgh, [3]The Ohio State University — Because children are becoming increasingly overweight, unhealthy and unfit, understanding the neurocognitive benefits of an active lifestyle in childhood has important public health and educational implications. Animal research has indicated that aerobic exercise is related to increased cell proliferation and survival in the hippocampus as well as enhanced hippocampal-dependent learning and memory. Recent evidence extends this relationship to elderly humans by suggesting that high aerobic fitness levels in older adults are associated with increased hippocampal volume and superior memory performance. The present study aimed to further extend the link between fitness, hippocampal volume, and memory to a sample of preadolescent children. To this end, magnetic resonance imaging (MRI) was employed to investigate whether high- and low-fit 9- and 10-year-old children showed differences in hippocampal volume and if the differences were related to performance on an item and relational memory task. Relational but not item memory is primarily supported by the hippocampus. Consistent with predictions, high-fit children showed greater bilateral hippocampal volumes. Furthermore, hippocampal volume was positively associated with performance on the relational but not the item memory task. The findings are the first to suggest that aerobic fitness can impact the structure and function of the developing human brain.

B83

THE INTERACTION OF INHIBITION AND CONCEPTUAL-SEMANTIC PROCESSING IN CHILDREN AS MEASURED BY THE N2-P3 RESPONSE DURING THREE GO-NOGO TASKS Mandy Maguire[1,2], Joshua White[1], Matthew Brier[2]; [1]University of Texas at Dallas, Callier Center for Communication Disorders, [2]University of Texas at Dallas, Center for BrainHealth — The N2-P3 ERP response to Go-NoGo tasks has provided an invaluable measure of inhibitory development in typical and disordered children. Unfortunately, past studies often vary based on age groups, methods, and stimuli making it difficult to determine what factors influence the development of these components. This project investigates how the N2 and P3 change based on systematic increases in conceptual-semantic difficulty across three Go-NoGo tasks. Twenty-two 7-8 year-olds and 22 10-11-year-olds completed all three tasks. The "Single" task included the repetition of one car (Go - 80% of the trials) and one dog (NoGo - 20% of the trials). The "Basic Category" task included multiple cars (Go-80%) and multiple dogs (NoGo-20%). The "Semantic Category" task included a range of objects (Go-80%) and animals (NoGo-20%). Thus, the tasks increased from using perceptual cues in the single task (identical items) to feature detection in the basic category task (legs, eyes vs wheels and windows) to semantic identification in the semantic category task (limited common perceptual features). Findings indicate that the N2 response does not change significantly with task difficulty. However, the amplitude for the P3 Go response increased linearly by task difficulty ($p = 0.026$), such that the most complex task no longer exhibited a significant Go-NoGo difference. This pattern held true for both age groups. Thus, conceptual-semantic complexity influences the P3 measure of inhibitory processing in a systematic way in children. This paradigm may be a key for investigating inhibitory dysfunction in disorders such as ADHD and autism.

B84

NORMAL AGING IMPAIRS A/B BUT ENHANCES A/NON-A PROTOTYPE LEARNING Brian D. Glass[1], Tanya Chotibut[1], Jennifer Pacheco[1], David M. Schnyer[1], W. Todd Maddox[1]; [1]The University of Texas at Austin — Behavioral and fMRI techniques have identified two dissociable prototype learning systems in young adults (Zeithamova et al., 2008). One system mediates A/B prototype learning where participants learn to categorize exemplars derived from two prototypes, and the other system mediates A/non-A prototype learning where participants learn to categorize exemplars derived from one prototype and non-categorical exemplars. The A/B task recruits brain regions associated with episodic memory retrieval and explicit reasoning (parahippocampus and inferior parietal and orbitofrontal cortices), while the A/non-A task recruits brain regions associated with nondeclarative learning (lateral occipital cortex and striatum). The effect of normal aging on A/B and A/non-A prototype learning has not been addressed. Whereas episodic memory and explicit reasoning are known to decline with normal aging (Hedden & Gabrieli, 2004), some forms of nondeclarative learning are spared in normal aging (Fera et al., 2005). The current study examined the performance of healthy younger (aged 18-29) and older adults (aged 60-81) in an A/B and A/non-A prototype learning task. In line with previous research showing episodic memory and explicit reasoning deficits, older adults were less accurate than younger adults in the A/B task. However, older adults were more accurate than younger adults in the A/non-A task. Follow-up analyses suggest that older adults were better able to classify the anti-prototype and were more accurate overall for non-A exemplars. The implications of this work for system-level interactions and potential compensatory mechanisms in normal aging are discussed.

B85

THE NETWORK ARCHITECTURE OF FUNCTIONALLY DEFINED REGIONS SPANNING THE BRAIN REORGANIZES FROM A PREDOMINANTLY LOCAL ARCHITECTURE IN CHILDREN TO A DISTRIBUTED, FUNCTIONAL ARCHITECTURE IN ADULTS Jonathan Power[1], Alexander Cohen[1], Steven Nelson[1], Gagan Wig[2], Fran Miezin[1], Alecia Vogel[1], Jessica Church[1], Kelly Anne Barnes[1], Bradley Schlaggar[1], Steve Petersen[1]; [1]Washington University in Saint Louis, [2]Harvard University — Several recent anatomical and resting state functional connectivity (rs-fcMRI) studies have described large-scale networks in the human brain. These studies have defined networks in terms of voxels or anatomical parcellations, which may not capture the behavior of functional areas. Here we examine the functional network structure of the brain across development based upon a combination of fMRI and rs-fcMRI analyses. We identified 164 regions of interest (ROIs) from meta-analyses (>300 subjects total) of signals related to task-level control, errors, reading, speech output, manual output, memory retrieval, and task-induced deactivations. 95 additional ROIs were found using rs-fcMRI tools that identify putative cortical areas (Cohen et al., 2008). These 259 spherical (10mm diameter) ROIs were applied as seeds in a rs-fcMRI analysis of a separate group of 210 subjects (7-31 years old) yielding within-subject pairwise correlations of all seed timecourses. Community detection analysis of these correlations divided the network into a relatively small number of "modules" with high confidence indices (Q). In adults (avg. age 26), several modules resembled familiar distributed networks, such as control and default networks. In children (avg. age 8), however, modules tended to group regions by anatomical proximity. Sensory cortex organization was largely preserved over development, including a distinction between dorsal and ventral somatomotor cortex, in which ventral "mouth" somatomotor regions were strongly associated with auditory processing regions. These data confirm previous reports of the developmental trajectories of specific functional networks, and suggest that from a functional perspective, sensory-motor cortex achieves a "mature" configuration earlier than association cortex.

Executive Processes: Goal Maintenance & Switching

B86

WHEN THE GOING GETS TOUGH, ATTENTION STARTS GOING Nikki Pratt[1], Adrian Willoughby[2], Diane Swick[1,3]; [1]VA Northern California Health Care System, [2]University of Birmingham, UK, [3]University of California, Davis — Previous research suggests that the prefrontal cortex is important in both directing attention to relevant stimuli and maintaining information in working memory (Corbetta & Shulman, 2002). Few studies, however, have reported the effect of working memory load on attention via top-down cortical connections. The following study addresses the extent to which working memory load influences early (P1) and late (P300) attentional ERP components using a dual task paradigm. Participants were presented with an arrow flanker task alone (single task condition) or along with a Sternberg memory task (dual task condition). In the flanker task, participants responded to the direction of a central arrow surrounded by congruent or incongruent arrows. In the dual task condition, participants were presented with a Sternberg task comprised of either 4 or 7 consonants to remember prior to a short block of 8 flanker trials. Behavioral and electrophysiological responses were analyzed in response to the flanker trials and compared across the single and dual task conditions. Participants were slower and less accurate on incongruent versus congruent trials, regardless of the load on working memory. Furthermore, both load conditions reduced accuracy on incongruent flanker trials. Likewise, amplitudes for the P1 and P300 components were diminished to flanker trials when the Sternberg memory set was introduced. This suggests that working memory influences attentional resources in the brain regardless of response conflict. Importantly, the P1 finding indicates that top-down attentional control over early visual processing is diminished by increasing demands in working memory.

B88

NEURAL SUBSTRATES OF COGNITIVE SWITCHING AND INHIBITION IN A FACE PROCESSING TASK Camille Piguet[1], Virginie Sterpenich[1], Martin Desseilles[1,2], Yann Cojan[1], Gilles Bertschy[2,3], Patrik Vuilleumier[1,2]; [1]Faculty of Medicine, Geneva, Switzerland, [2]University Hospital of Geneva, Switzerland, [3]University Hospital of Strasbourg, France — We frequently need to change our current occupation, an operation requiring additional cognitive demands. Switch from one task to another may involve two distinct processes: the need to inhibit the previously relevant task-set, and the ability to switch to another one. Here we tested whether these two processes are underlined by two separate brain networks and to which extent these networks might be influenced by the nature of the task when performed on different aspects of faces. We used functional magnetic resonance imaging in healthy human volunteers who had to perform a categorization task on emotional faces, according to three different judgment rules (color, gender or emotional expression). Our paradigm allowed us to separate neural activity associated with inhibition and switching according to the sequence of the tasks used on successive trials. Our results reveal that two regions showed consistent activation for switching condition independently of the three different tasks, namely the medial superior parietal lobule bilaterally and the posterior cingulate gyrus. Superior parietal cortex showed reduced activation in inhibition conditions, but no region was activated by inhibition across all tasks. However, inhibition produced deactivations in distinct brains regions. Most critically, the insula and superior temporal sulcus were deactivated when emotional processing was inhibited during switch. We conclude that, unlike for switching ability mediated by fronto-parietal and striatal circuits, there is no general effect of task-set inhibition, but inhibition leads to a selective deactivation of brain regions normally engaged in a specific task.

B89

IMPROVED PERFORMANCE RELATES TO ADDITIONAL CONTROL PROCESSES DURING THE STROOP COLOR-WORD TASK Gregory C. Burgess[1], Roselinde Kaiser[1], Jessica R. Andrews-Hanna[1], Akira Miyake[1], Marie T. Banich[1,2]; [1]University of Colorado - Boulder, [2]University of Colorado - Denver — A frontoparietal network, including dorsolateral PFC, dorsal ACC, and lateral parietal lobule, has been implicated in attentional control. These regions tend to be activated on average across individuals performing the Stroop Task, suggesting that processes subserved by these regions are necessary for attentional control. Unfortunately, far less attention has been given to control processes that are differentially activated by better-performing individuals. The current study investigated whether better attentional control during the Stroop task resulted from increased recruitment of this frontoparietal network, or from recruitment of additional regions above and beyond this frontoparietal network. We measured fMRI activation and behavioral interference during the Stroop Task in a group of 50 young adults. On average, the group activated the typical frontoparietal network frequently implicated in attentional control. As individuals performed better (i.e., showed reduced behavioral interference), they demonstrated increased activation of overlapping and adjacent portions of the frontoparietal network. However, better performance also related to increased activation of regions that were not recruited by the group as a whole, including regions related to "cognitive branching" and memory retrieval (e.g., left anterior PFC (BA10) and right hippocampus). This pattern suggests that improved attentional control performance is related both to processes employed by the group as a whole (e.g., active maintenance of task goals, response inhibition, and response selection) and to additional processes that were not utilized by the average participant. We argue that a complete picture of neural processes involved in attentional control requires consideration of variation related to individual differences in performance.

B90

DISTINCT REPRESENTATION OF GOAL COMPLETION FROM OTHER TASK RELEVANT INFORMATION IN THE FRONTO-PARIETAL NETWORK Ausaf Farooqui[1], Russell Thompson[1], John Duncan[1]; [1]MRC - Cognition and Brain Sciences Unit, Cambridge, UK — Converging evidence from a range of sources implicates a network of frontal and parietal regions as playing a crucial role in cognitive control. Further, these areas have been shown to hold a selective representation of task relevant information. However, functional distinctions within these areas are not fully understood. Here we show that a distinct set of areas within this network is preferentially sensitive to information that marks task completion. Methods: Subjects had to covertly detect the letters of a cued three-letter string. Detection of all three letters in their proper order completed the task and made the subjects eligible for a reward that could be had by correctly answering a probe question related to the task at the end of the trial. Thus, while all target letters were relevant to the task, only the third target letter marked its completion. Result: A network of frontal areas including ventro-lateral prefrontal cortex, inferior frontal junction, and supplementary motor area, together with lateral intra-parietal sulcus showed increased activity in response to detection of the first two target letters. In contrast,anterior regions of DLPFC and ACC, together with medial parietal areas, showed increased activity only in response to the detection of the final target, suggesting a distinct representation of information marking the completion of task from other task relevant information.

B91

UNDERPINNINGS OF THE COSTS OF FLEXIBILITY IN PRESCHOOL CHILDREN: THE ROLES OF INHIBITION AND WORKING MEMORY Nicolas Chevalier[1], Kimberly A. Espy[1], Tiffany Sheffield[1], Jennifer M. Nelson[1], Caron A. C. Clark[1], Sandra A. Wiebe[2]; [1]University of Nebraska-Lincoln, Nebraska, [2]University of Alberta, Edmonton, Alberta — The present study aimed to understand the basis for the development of flexibility by understanding its main underlying cognitive components, goal setting and switch implementation, at an age of rapid acquisition. We examined the potentially differential effects of inhibition and working memory on goal setting and switch implementation in preschoolers. To this end, 300 4½-year-old children's flexibility, inhibition, and working memory were respectively assessed with the Shape School, which required switching between color and shape naming tasks, a go-nogo task, which required suppressing a prepotent response, and a working memory span task, which required recalling lists of items in the correct order. Mixing costs and local costs were computed to specifically capture respectively the difficulty of goal setting and switch implementation on the Shape School. Individual differences in both inhibition and working memory resources significantly predicted both local and mixing costs, though working memory more systematically influenced mixing costs and inhibition had a stronger influence on local costs. Furthermore, higher inhibition or working memory resources often resulted in better switching accuracy, though at the expense of slower responding. Such speed/accuracy tradeoffs contrast with what is generally reported in older participants, presumably because of rapid skill acquisition at preschool age. Consistent with evidence for less fractionation of executive control in preschoolers than later in development, both goal setting and switch implementation were found to relate to both inhibition and working memory.

B92

UNDERLYING PROCESSES OF SWITCHING BETWEEN TASKS: RECONFIGURATION OR ADAPTATION? Wouter De Baene[1], Simone Kühn[1], Marcel Brass[1]; [1]Ghent University — People show a remarkable flexibility in switching between multiple tasks. However, people are generally slower and less accurate at switching than at repeating tasks (i.e. the "switch-cost"). The switching paradigm has frequently been used to systematically examine control processes in human cognition. In fMRI studies, many regions thought to be involved in cognitive control showed increased activation during switching compared to repeating. The dominant account for this activation difference is that a switch engages an active reconfiguration process to tune the cognitive system for a proper task execution. Such process will normally not be needed when repeating a task. However, higher activation patterns for switch than repeat trials could also be explained by adaptation in the repeat trials. Adaptation refers to the decrease in neuronal activity when a stimulus is repeated. In this fMRI study, we examined which account better explains the differential activation in preparing a switch compared to a repeat trial. Subjects needed to switch between a motion and color task. To disentangle reconfiguration from adaptation, we generated different parametric models for these views and used bayesian model selection to find the best fitting model for the different areas. Both in areas involved in cognitive control functions as in task-specific regions, the adaptation model fitted the data much better than the reconfiguration model. We argue that the dominant reconfiguration view on task switching should be revised. Furthermore, our data provide first evidence for adaptation on an abstract representational level, namely for the representation of task sets.

B93

THE NEUROCOMPUTATIONAL MECHANISMS OF EXPLORATORY AND EXPLOITATIVE BEHAVIOR Nicole M. Long[1], Bradley B. Doll[1], Michael J. Frank[1], David Badre[1]; [1]Brown University — When the outcomes of two choices are clearly known, it is easy to choose between them. But with uncertain outcomes, how do individuals decide whether to stick with the status quo or to try an unexplored choice that might be more rewarding? Neurogenetic research has shown that prefrontal dopamine function, as measured by the COMT gene, predicts the degree to which individuals explore as a function of uncertainty, whereas striatal dopaminergic genes predict exploitation. However, left unanswered is the question of which prefrontal region tracks uncertainty for the purpose of exploration. To address this question, the present experiment used fMRI to scan a previously established reinforcement learning task in combination with computational modeling to derive trial-by-trial estimates of uncertainty regarding individual choices, and reward prediction error following decision outcomes. Exploration is predicted to occur as a function of the difference in uncertainty among choices. On each trial, participants observed a clock face whose hand rotated clockwise over the course of 5s. The goal was to respond at the time during the rotation that afforded the most points. Reward schedules were such that expected value could increase, decrease, or remain constant with respect to response time. Preliminary results suggest that frontal pole tracks exploration as a function of the relative uncertainty between choices (i.e., fast or slow responses), while the basal ganglia track reward prediction error. These results can lend further insight into the specific fronto-striatal systems supporting the decision to explore or exploit.

B94

DRD2 GENOTYPE MODULATES THE EFFECT OF MOTIVATION ON PREFRONTAL COGNITIVE PROCESSING Christian Fiebach[1], Christine Stelzel[1], Ulrike Basten[1], Ricarda Steinmayr[1], Christian Montag[2], Birgit Spinath[1], Martin Reuter[2]; [1]University of Heidelberg, Germany, [2]University of Bonn, Germany — It is long known that motivational traits influence the performance in cognitive tasks. Here we investigated how regulatory focus modulates brain activation during a demanding cognitive task, i.e., rule-based task switching. Consistent with previous results, task switching activated prefrontal regions, particularly the inferior frontal junction area (IFJ) and an area more anteriorly in the middle frontal gyrus. Persons with a strong self-regulatory focus on promotion showed relatively greater task-switching activity in these regions compared to persons with a weaker promotion focus, suggesting that promotion focused individuals invest more neural effort into task performance. Including molecular genetic data on dopaminergic gene polymorphisms, we tested the hypothesis that a promotion focus depends on dopamine system activity. We observed that individuals without an A1 allele of the DRD2/ANKK1-TaqIa polymorphism, i.e., individuals with relatively greater D2 receptor density, have a significantly increased promotion focus. However, an effect of promotion focus on brain activation as described above was observed only for A1 allele carriers, i.e., for individuals with a relatively reduced density of D2 receptors who are more efficient in cognitive flexibility tasks (Stelzel et al., submitted). Non-carriers of the A1 allele, in contrast, showed a reverse IFJ-correlation with the strength of prevention focus, suggesting that a prevention focus leads to less recruitment of task-related brain regions in this gene variant. Taken together, these results indicate that motivational traits influence the neural effort invested into cognitive task performance. The strength of these influences, however, depends on the efficiency of dopaminergic neural systems.

B95

ELECTROPHYSIOLOGICAL CORRELATES OF TASK SWITCHING WITHIN THE SAME-DIFFERENT JUDGMENT PARADIGM Shulan Hsieh[1], Mengyao Wu[2]; [1]Cognitive Electrophysiology Laboratory, Institute of Cognitive Science, National Cheng Kung University, Tainan, Taiwan, [2]National Chung Cheng University, Chia-Yi, Taiwan — The aim of this study was to explore electrophysiological correlates of re-orienting of attention to different aspects of task processing by means of examining task switches within the same-different judgment paradigm. In the present study, two digits were presented simultaneously and participants were asked to judge the sameness or differences of pairs of digits according to either their perceptual dimension or conceptual dimension. All four task-relevant dimensions for same-different judgment varied randomly from trial to trial in a block, with the constraint that a total of shifting probability was equal to repeat trials. The length of preparatory interval, i.e., cue-target interval of 200 ms or 1000 ms, was also manipulated. The behavioral data showed that mean reaction time was slower in the switch than in the repeat trials and the same-different judgment was faster when based on perceptual dimensions than based on conceptual dimensions. The current ERP results further showed that task switching did not modulate a similar stimulus-locked switch-related ERP component as found previously. The implications of the current results indicate there may be fundamental differences between different task switching paradigms.

B96

EXPERIENCE-DEPENDENT BRAIN STRUCTURAL PLASTICITY IN SIMULTANEOUS LANGUAGE INTERPRETERS Narly Golestani[1,2], Barbara Moser-Mercer[1], Alexis Hervais-Adelman[1], Micah Murray[3,4], Ulrich Frauenfelder[1], Reto Meuli[3], Patric Hagmann[3,5], Sophie K. Scott[2], Christoph Michel[1]; [1]University of Geneva, [2]University College London, [3]Centre Hospitalier Universitaire Vaudois, [4]University of Lausanne, [5]Ecole Polytechnique Fédéral de Lausanne — Previous work has shown experience-dependent structural plasticity in the human adult brain. For example, in the domain of language, phoneticians with more phonetic transcription experience have a larger left pars opercularis (subregion of Broca's area) than those with less such experience, suggesting that such training results in structural change in a brain region involved in phonetic segmentation (Golestani et al, submitted). Here, we examined experience-dependent brain structural change longitudinally in a new group of language experts in training: simultaneous language interpreters. Simultaneous language interpretation is a highly complex cognitive task, involving performing active, 'on-line' switching between languages, and producing speech in one language while fully processing it in another. Interpreters are thus very skilled at language control, and flexible, rapid online thinking. We scanned 10 interpretations students using high-resolution structural magnetic resonance imaging before, during, and after a 15-month intensive training program. We also scanned 12 healthy students in other domains, matched for age, sex, and multilingualism with the interpreters, at similar time points, to control for brain changes resulting from non-specific learning. We found evidence for brain structural plasticity in brain regions involved in processing phonology, grammar, and linguistic meaning as well as in more 'executive' regions involved in controlled access to stored conceptual representations and decision making (the left pars orbitalis and supramarginal gyrus) in the interpreters but not in the controls. Results suggest that intensive training in a complex cognitive skill involving multiple languages results in brain structural change in the very regions involved in expert performance.

B97

SPATIOTEMPORAL ANALYSIS OF SET SHIFTING USING MAGNETOENCEPHALOGRAPHY Julie Vidal[1], Elizabeth W. Pang[1], Travis Mills[1], Margot J. Taylor[1]; [1]Hospital for Sick Children, Toronto, Canada — Cognitive flexibility has been investigated using set-shifting tasks; neuroimaging studies showing the critical role of the prefrontal cortex. Our aim was to characterize the spatiotemporal correlates of the brain mechanisms involved in shifting, particularly in the frontal lobes, using the fine temporal and spatial resolution of magnetoencephalography (MEG). Sixteen healthy right-handed adults participated in this study. Subjects matched one of two coloured images with a target image by either the colour or shape dimension of the target. Series of at least three trials were included within a set before a rule shift occurred. Shifts were either intradimensional (ID) or extradimensional (ED). MEG was recorded using a 151 channel CTF system. Source analyses used the anatomical MRI of each participant. We analyzed responses to the first (Shift) and third (Repeat) trials in a set using a beamformer algorithm and compared them separately for ID and ED sets; shifts were compared between ID and ED. Despite the absence of obvious differences at the sensor level among these conditions, source analyses showed stronger activity starting at 200ms post-stimulus-onset in: 1) right middle frontal gyrus for ED shifts compared to ED repeats and for ED shifts compared to ID shifts, and 2) left prefrontal areas in ID shifts vs. both ID repeats and ED shifts. Time-frequency analyses specified the frequency bands where changes in brain oscillations occurred. These findings provide precise information about the timing and the localization within the prefrontal cortex of the brain ability to shift from a rule to another.

B98

ACETYLCHOLINE MODULATES FRONTOPARIETAL RESPONSE TO DEMANDS FOR COGNITIVE CONTROL Mary K. Askren[1], Elise Demeter[1], Mary Winters[1], Stephan Taylor[1], Martin Sarter[1], Cindy Lustig[1]; [1]University of Michigan — Cognitive neuroscience research in primates (including human neuroimaging) emphasizes the involvement of frontoparietal networks in response to demands for cognitive control. Behavioral neuroscience research with rodents indicates that increases in acetylcholine play a critical role in the brain's response to these demands. The present experiment integrates these approaches by using a task-switching procedure to vary demands for cognitive control and donepezil hydrochloride (an acetylcholinesterase inhibitor) to vary extracellular acetylcholine levels. Demand for cognitive control varied with the requirement to attend to external cues indicating the currently-relevant task rule (low: all trials used the same rule; intermediate: current trial used the same rule as the previous trial; high: current trial required switching to a new rule in response to the cue). Young adults (age 18-30, n = 20 per group) were tested at baseline and subsequently scanned 3 hours after receiving a placebo pill, 5 mg, or 10 mg donepezil. Demand-related frontoparietal activations differed most between the placebo and 5 mg conditions, suggesting a U-shaped dose-response curve. Under placebo, the largest activation increases occurred in the shift from low- to intermediate-demand, where cue-processing first became relevant. The 5 mg condition did not show significant differences between low- and intermediate-demand. Instead, activation increases were isolated to the high-demand condition. This suggests that the 5 mg group only increased engagement of frontoparietal control regions when a cue-based switch was immediately required. Moderate increases in extracellular acetylcholine may facilitate rapid shifting between internally-focused and externally-focused processing modes, allowing more selective engagement of frontoparietal networks.

B99

DISTRIBUTED PATTERNS OF ACTIVATION IN THE PREFRONTAL CORTEX REFLECT TASK-RELEVANT VISUAL DIMENSIONS OF A STIMULUS David Pagliaccio[1], Sophie Lebrecht[1], David Badre[1]; [1]Brown University — Prefrontal cortex (PFC) is thought to maintain contextual information, rules, and goals in order to guide action. However, the nature of the contextual information maintained by these various frontal regions remains an open question. In the present study, multi-voxel pattern analysis (MVPA) of fMRI data was used to index the distributed patterns of activation in PFC associated with representation of specific task-relevant dimensions of visual input and how multiple such contextual representations are maintained simultaneously. On each trial, participants were presented one of two abstract shapes appearing in one of two orientations and in one of two colors. Two of the three dimensions (color, shape, or orientation) were paired with particular manual responses based on their identity. The third dimension cued one of these two dimensions as the relevant response pairing for that trial. Thus, across all trials, one dimension was always relevant and cued which of the two other dimensions was relevant on a given trial. MVPA prediction accuracy was used to index when stimulus information along each of these three dimensions was being maintained by PFC. Initial results indicate that PFC codes for only those visual dimensions relevant to selecting a response or set of rules. By contrast, classifier success indicated that visual areas code for these same dimensions regardless of task-relevance. These results are consistent with the hypothesis that PFC flexibly maintains contextual information in working memory that is relevant to selecting a response, regardless of the specific content of that context.

B100

THE D2 AGONIST BROMOCRIPTINE MODULATES PREFRONTAL ACTIVITY ASSOCIATED WITH FLEXIBILITY IN TASK SWITCHING Christine Stelzel[1], Christian J. Fiebach[1], Roshan Cools[2], Mark D'Esposito[3]; [1]University of Heidelberg, [2]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, [3]University of California, Berkeley — Recent imaging genetics studies suggest a role of the dopamine D2 receptor in the flexible adaptation of behavior in humans based on differences in fronto-striatal activity between genetic groups. However, the quasi-experimental nature of these genetic studies limits the causal interpretability of these findings. In the present study we provide converging evidence for our previous finding of an association of genetic variations in the D2 receptor gene with prefrontal activity changes in a rule-based task-switching paradigm. Using the D2 receptor agonist bromocriptine, we tested whether increased D2 receptor stimulation causes increased prefrontal task-switching-related activity as suggested by the genetic study. In two separate fMRI sessions (placebo/drug), participants performed 5 or odd/even decisions on number stimuli, depending on a task cue. Increases in switching-related reaction times under bromocriptine were accompanied by selective BOLD increases in prefrontal regions involved in task switching, i.e., the left inferior frontal junction (IFJ) region and the anterior cingulate cortex. Importantly, the greater switching-related IFJ activity under the D2 receptor agonist concurs with the finding of greater activity in this region for individuals with genetically determined high D2 receptor density. This result further supports the assumption that cognitive flexibility is related to the D2 system that exerts its effects in prefrontal regions when task sets have to be switched flexibly from trial to trial.

B101

COMPETING STRATEGIES FOR PRONOUN RESOLUTION Megan Reilly[1], Corey McMillan[1], Robin Clark[1], Murray Grossman[1]; [1]University of Pennsylvania — Individuals can use at least two decision-making strategies to resolve pronoun reference in ambiguous sentences like "The client chased the king. He laughed". A syntactic strategy relies on assigning a pronoun to the preferred subject ("client") of a sentence. A semantic strategy relies on gender information ("king" is male; "client" is gender-neutral). We hypothesize that successful resolution of pronoun reference requires, in part, the ability to choose between these strategies. bvFTD patients have mental flexibility limitations with relative sparing of language, and we predicted impaired pronoun reference resolution due to limited ability to use each strategy appropriately. 14 healthy seniors (WNL) and 9 bvFTD patients matched for age and education were presented with 40 unambiguous ("The king chased the princess. He laughed") and 40 ambiguous ("The king chased the client. He laughed") sentence pairs. We manipulated whether the correct referent was the subject or object (in unambiguous pairs) or whether the gender-biased noun (king) was the subject or object (in ambiguous pairs). Participants were instructed to identify the pronoun's referent. We evaluated mental flexibility using Oral Trails. bvFTD are less accurate for pronouns referring to the object relative to the subject [$t(8)=2.33$, $p<0.05$] in unambiguous items. In ambiguous stimuli, bvFTD select the subject noun (24% of responses) more than WNL (5% of responses) when the gender-biased noun is the object [$t(21)=2.84$, $p=0.01$]. This inappropriate use of a syntactic strategy by bvFTD correlates with Oral Trails ($r=-0.70$, $p=0.05$), which suggests that a limitation in mental flexibility may affect pronoun resolution.

B102

UNPACKING THE PROSPECTIVE CODE AVAILABLE UNDER DIFFERENTIAL OUTCOMES TRAINING Leh Woon Mok[1]; [1]National Institute of Education, Nanyang Technological University, Singapore — This study examined a form of prospection that involved minimal self-projection. The conditional discrimination choice task was used, which modeled real-life delayed choices learned and made conditionally based on the presenting discriminative/cue situation. Each correct cue-choice occurrence was followed by an outcome stimulus. Under the "differential outcomes" (DO) training procedure, outcome stimuli were unique to each correct cue-choice occurrence ("cue-unique"). The DO procedure produces consistently more accurate and faster learning, as compared to following all correct choices with a "common outcome" (CO), or random, "non-differential outcomes" (NDO). Healthy adults performed discrimination tasks under the DO, CO and NDO procedures, and related comparison tasks, while undergoing functional magnetic resonance imaging (fMRI). Differential outcomes were sensory-perceptual events (visual vs. auditory). Sensory-specific cortices and related brain regions prospectively coded the stimulus content of the respectively expected cue-unique outcomes (Mok et al., 2009). These cue-unique outcome expectations "enriched" the prospective code available to bridge the memory delay. Previous results indicated that, facilitated by the posterior parietal cortex, this enrichment promoted an earlier transition from retrospection (of cue information) to prospection (of events expected after the delay, e.g., correct choice and/or anticipated outcome). Here, the prospective code available under DO training was further unpacked. Choice stimuli were visual objects. Conjunction analyses across tasks implicated prospective coding also for: the expected correct choice in precuneus (possibly a response intention), and visual-specific inferior, lateral and medial frontal, and lingual gyri, and cerebellum; and a general anticipatory response in anterior insula, likely for an available (sensory-perceptual) outcome goal.

B103

A COMPONENTIAL ANALYSIS OF TASK-SET SWITCHING IN PARKINSON'S DISEASE Li Jingling[1], T-H. Chang[2], C-H. Tsai[1,3,4], M-K. Lu[3,5], Y-C. Lin[3]; [1]Graduate Institute of Neural and Cognitive Sciences, China Medical University, Taichung, Taiwan, [2]China Medical University, Taichung, Taiwan, [3]Neuroscience Laboratory, China Medical University Hospital, Taichung, Taiwan, [4]Graduate Institute of Medical Science, China Medical University, Taichung, Taiwan, [5]Motor Cortex Group, Goethe-University, Frankfurt am Main, Germany — Patients with Parkinson 's disease (PD) have been reported to have problems in cognitive flexibility. In this study, we further investigated which cognitive components of this deficit in PD patients correlate with their disease and their 99mTc-TRODAT-1(dopamine transporter) SPECT image. To this aim, we included not only age-matched controls but also a young group to study the relative contributions of the disease and aging to cognitive flexibility. Twenty-two patients with PD, 28 healthy age-matched older people, and 31 healthy young controls, were recruited in this study. Three components, the mixing cost, the switching cost, and the congruency effect, were measured in a task-set switching paradigm. The participants performed two simple tasks either separately in different blocks or alternating in a mixed block. The activation of the striatum area of PD's 99mTc-TRODAT-1 SPECT image was calculated relative to the occipital lobe as an index of strength of the dopamine transporters in the striatum. PD patients performed worse in switching cost than older controls, and have larger mixing cost than young controls. Also, aging affects both the mixing cost and the congruency effect, but not the switching cost. Furthermore, the index of the 99mTc-TRODAT-1 SPECT image significantly correlated with patients' mixing cost. Our findings suggest that (1) PD patients uniquely impaired in switching mental sets from one to the other, and (2) their deficits in keeping two mental sets in mind simultaneously correlate with the loss of dopamine in striatum.

B104

PRIMING AND BACKWARD INTERFERENCE IN THE HUMAN BRAIN: STIMULUS ONSET ASYNCHRONY MANIPULATIONS REVEAL PROCESSING INTERACTIONS DURING THE STROOP AND REVERSE STROOP TASKS Lawrence Appelbaum[1], Carsten Boehler[1], Marty Woldorff[1]; [1]Duke University — Stroop interference provides a widely used and powerful marker of executive cognitive function. Moreover, the Stroop-task stimulus components can be separated in time in order to explicitly study the dynamics of information processing in the human brain. In the present work, we measured behavioral and neural markers of interference using high-density ERPs as subjects performed variants of the Stroop (color-naming) and reverse-Stroop (word-naming) tasks in which the task-irrelevant component could appear at one of five stimulus onset asynchronies (SOAs) relative to the task-relevant component: -200 or -100 ms before, simultaneously, or +100 or +200 ms after. Experimental sessions were run with both equal (50-50%) and unequal (80-20%) congruent and incongruent pairings, and with and without the inclusion of neutral distractors, to assess the relationships between task-set (color- versus word-naming), stimulus context (incongruency probability), and SOA-incongruency interactions. For all task variants, stimulus incongruency interacted with SOA producing greater conflict-related behavioral and ERP effects when the irrelevant stimulus component preceded the task-relevant target, and diminished but still significant effects when the task-irrelevant stimulus component followed. These 'priming' and 'backward interference' SOA effects both interacted with task, showing a nearly 50% reduction in behavioral and neural interference in the equal-probability reverse-Stroop task (e.g., prototypical trial-type frequency effects). Interestingly, ERP incongruency effects also produced opposite accelerating and decelerating latency patterns across SOAs for the two tasks, reflecting faster processing speeds for words than colors in these tasks. These results provide powerful examples of how cognitive task and stimulus conflict interact in the human brain.

B105

THE IMPACT OF PARKINSON'S DISEASE ON THE EFFECTS OF A MATCH BETWEEN GLOBAL AND LOCAL INCENTIVES IN RULE-BASED CATEGORY LEARNING Monica Zilioli[1], W. Todd Maddox[2], Edward Drasby[1], Shawn Ell[1]; [1]University of Maine, [2]University of Texas — Recent data suggest that performance on rule-based category learning tasks can be modulated by manipulating the extent to which global and local incentives match. The goal of the present study was to investigate if the effects of the match between global and local incentives are mediated by fronto-striatal networks by using Parkinson's disease (PD) as a model of fronto-striatal dysfunction. Global incentive was manipulated by placing participants in a promotion (sensitive to gains) or prevention (sensitive to losses) regulatory focus. The local incentive was to maximize gains by earning points on a trial-by-trial basis and was constant across conditions. Participants were trained on a rule-based task where successful performance required learning to attend to a single, relevant stimulus dimension and ignore three irrelevant stimulus dimensions. Once a learning criterion was met, the categorization rule was changed (i.e., a previously irrelevant dimensions became relevant). PD patients performed similar to healthy controls on the first rule. When the categorization rule changed, however, the performance of the two groups diverged. For healthy control participants, there was a savings when there was a match between the global and local incentives (i.e., promotion) and a cost when there was a mismatch between the global and local incentives (i.e., prevention). In contrast, for individuals with PD, there was a cost of similar magnitude for both the match and mismatch conditions. These results suggest that the fronto-striatal networks disrupted in PD mediate the effects of a match between global and local incentives in rule-based category learning.

B106

SEX DIFFERENCES UNDER DIAZEPAM IN RULE GUIDED BEHAVIOR: AN FMRI STUDY Zeidy Munoz-Torres[1], Jorge Armony[3], David Trejo-Martínez[2], Rubén Conde[2], María Corsi-Cabrera[1]; [1]Laboratory of Sleep, Faculty of Psychology, Universidad Nacional Autónoma de México, [2]Module of Neuroimage and Cognition, Hospital Ángeles del Pedregal, [3]Douglas Mental Health University Institute, McGill University — Benzodiazepines (BZD) modulate GABA-A receptor by increasing Cl- conductance across the membrane. In addition, progesterone and its metabolites have been shown to exert modulatory effects on the GABA-A receptor complex. Enhancement of inhibition with BDZ can have important effects at the cognitive level, including executive functions such as behaviour guided by complex and arbitrary rules. To investigate the neural correlates of these effects, we explored the influence of BDZ on brain activity during a rule guided-behavior task using fMRI. Eighteen healthy volunteers participated in a single-blind study. BOLD activity was measured 2 hours after a single-dose (10 mg) of diazepam (DZ) or placebo (PL) administration in two counterbalanced sessions during the rule guided task. Performance was analyzed in two tasks: simple rule and complex rules modalities. We found that a single dose of DZ was enough to increase reaction times and reduce accuracy in the complex-rules with greater effects in women than in men. Task performance under DZ did not activate the frontal regions as in PL, while in posterior areas an increase in BOLD activity was observed, with clusters in temporal, parietal and occipital cortices, more evident in men than in women. Thus, DZ appears to exert a different antero-posterior asymmetric activation pattern between women and men. These results suggest that the enhanced inhibition produced by DZ alters the activity in the neural networks involved in complex rule-guided behaviors, leading to a decrease in performance. The sex differences effects of DZ may have clinically relevant implications for therapeutic strategies.

Executive Processes: Other

B107

FUNCTIONAL SPECIALIZATION WITHIN RIGHT VENTROLATERAL PREFRONTAL CORTEX: A META-ANALYSIS OF STOPPING, REFLEXIVE ORIENTING, AND MATERIAL SPECIFICITY EFFECTS Benjamin J. Levy[1], Anthony D. Wagner[1]; [1]Neuroscience Program, Stanford University — Delineating the functional organization of prefrontal cortex is central to advancing neural and psychological models of goal-directed cognition. Over the past decade, considerable functional neuroimaging data indicate that specific forms of cognitive control are consistently associated with distinct subregions of ventrolateral prefrontal cortex (VLPFC). While this has led to increasingly specified models of left VLPFC functioning, less is known about functional differentiation within right VLPFC. Recently, two proposals have dominated theories about the role of right VLPFC: stopping of motor responses and reflexive orienting to abrupt perceptual onsets. At present, it remains unclear whether these processes activate the same or distinct VLPFC subregion(s), and whether these putative processes are inherently linked (e.g., stopping may often involve orienting to an infrequent stop cue). Moreover, it is also unclear whether and how these perspectives can account for the broad range of goal-directed tasks that activate right VLPFC. For example, it is not obvious how either could account for the frequent observation of right VLPFC activation during processing of, and episodic memory for, visuospatial stimuli. Here we review these disparate literatures through meta-analysis of right VLPFC function. ALE analyses revealed both overlap and divergence in the VLPFC subregions associated with stopping, reflexive orienting, and visuospatial processing tasks. These results advance understanding of the functional heterogeneity within right VLPFC, and we discuss how this heterogeneity relates to hierarchical theories of PFC functional organization and cognitive control. Funded by NIMH (5R01–MH080309).

B108

A SYSTEMS MODEL FOR SELECTIVITY BETWEEN DEFAULT AND TASK MODES Kevin Brown[1], Jonathan Smallwood[1], Jonathan Schooler[1], Jean Carlson[1]; [1]University of California, Santa Barbara — Neuroimaging data suggests that the human brain has at least two attentional states - a task-focused mode in which attention is focused externally on the task at hand and a less constrained internal mode dubbed the default state. An essential step to understanding the distinct processes governed by these different states is to understand the way in which the brain divides finite cognitive resources and selects among externally- and internally-driven goal states. We present a coarse-grained, systems-level dynamical model which explores the temporal nature of the interaction between these different modes, in which we examine the role of the locus coeruleus in modulating between external events and internally generated signals. We discuss the implications of the model for understanding mindwandering and attentional failures, which we characterize as partitioning of cognitive effort away from externally-driven tasks to internally-generated ones. We also discuss the potential of directly fitting the dynamical model to multimodal dynamical measurements (surface EEG, BOLD fMRI and pupillometry data).

B109

BRAIN BASES OF COGNITIVE EFFICIENCY: TRIAL-LEVEL PROCESSING SPEED AS A PREDICTOR OF BOLD SIGNAL-CHANGE Neena K. Rao[1], Michael A. Motes[1,2], Bart Rypma[1,2]; [1]Center for BrainHealth & School of Behavioral and Brain Sciences University of Texas at Dallas, [2]University of Texas Southwestern Medical Center — Previous neuroimaging research on brain bases of cognitive efficiency has examined inter-subject variability. Group-level correlations between performance and neural activity have shown that better performance is supported by less prefrontal cortex (PFC) activity, at least among younger adults. In this study, however, brain bases of cognitive efficiency were studied at the intra-subject level. Subject-level correlations between trial-level reaction time (RT) and fMRI BOLD signal-change were examined. While undergoing fMRI, participants completed a scanner-adapted version of Digit-Symbol Substitution (Wechsler, 1997), a measure of processing speed. A key of nine digit-symbol pairings and a single digit-symbol probe pair appeared simultaneously on the screen (for 4 s). Participants were to indicate whether the probe was present in the key or absent. Linear deconvolution, using an RT time-series model (derived from proportional scaling of an event-related HRF model by trial-level RT), was used to evaluate relationships between trial-level RT and BOLD percent signal-change. Group-level analyses of the RT-BOLD correlations revealed that in multiple brain regions faster RTs were associated with less signal-change. Thus, cognitive efficiency was associated with neural efficiency over a broad network of brain regions. Comparisons between trials in which the probe was present versus those in which it was absent revealed that RTs mediated activation within parts of PFC. When the probe was present, greater activation within left PFC was associated with faster RT; however, when the probe was absent, greater activation within right PFC was associated with slower RT, suggesting that cognitive efficiency might be associated with lateralized PFC efficiency.

B110

EFFECT OF L-DOPA ON BRAIN ACTIVITY PATTERNS DURING A MOTOR TASK IN PARKINSON'S PATIENTS ON AND OFF MEDICATION: AN FMRI STUDY Kristina Martinu[1], Clotilde Degroot[1], Antonio Strafella[2], Oury Monchi[1]; [1]Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal, [2]CAMH-PET Imaging Center / Toronto Western Hospital — Parkinson's patients manifest cognitive and motor symptoms. Using a cognitive fMRI task, we previously showed that activity in cortical regions vary depending on striatal recruitment. Also, L-dopa helped restore a normal pattern in the motor but not the cognitive cortico-striatal loop. Furthermore, when comparing self-initiated (SI), externally-triggered (ET), and repeated (Ctl) movements in healthy participants, we found activations in the motor loop for SI and ET movements, and in the cognitive loop for SI movements. We investigated L-dopa effects on activation patterns using the same finger-movement task. We predicted that patients OFF medication would have altered cortico-striatal patterns of activity and that medication should partially restore the activity observed in controls. 15 Parkinson's patients underwent two fMRI sessions, once on, once off medication. Participants used their right hand to perform SI, ET, and Ctl movements. 15 healthy controls were also recruited. Preliminary results indicate increased activity in the PFC and striatum with increasing task complexity. Patients ON or OFF do not show such an increase in prefrontal activity, but ON patients exhibit similar patterns of cortical activity as the controls in regions such as the parietal and premotor cortex. Greater putamen activation ON than OFF or control is observed for all conditions. Our results show that activity in the premotor and parietal regions is partly restored when patients are

ON, although task difficulty has a stronger effect. While there is an effect of medication on the motor loop, these results support the lack of L-dopa effect on the cognitive loop.

B111

MAPPING DISSOCIABLE COMPONENTS OF FRONTAL-EXECUTIVE FUNCTION Ami Tsuchida[1,2], Lesley Fellows[1,2]; [1]Montréal Neurological Institute, [2]McGill University — The prefrontal cortex (PFC) plays a central role in higher order 'executive' functions critical for flexible, goal-directed behavior, including planning, problem-solving and decision-making. A growing body of fMRI work argues for fine-grained distinctions in the functions of specific regions within PFC. However, the component processes underlying executive functions, and their anatomical substrates, remain hotly debated. Loss-of-function studies are an important source of converging evidence in this debate. Dissociable deficits are a particularly powerful form of evidence that can emerge from such studies. Here, we aimed to test putative functional specializations within PFC in a large sample of patients with focal damage affecting various sectors of the frontal lobes. A battery of tasks was chosen to selectively tap a range of component processes, including working memory, response inhibition, selective attention, and reinforcement learning. The focus was on components thought to relate to different major subregions within PFC. The battery was administered to 40 subjects with chronic, focal frontal lobe damage, and to 50 demographically-matched healthy participants. Performance on all 7 tasks was worse in those with frontal damage compared to controls. However, there was evidence of functional specialization: Nearly all patients were impaired at one or more task, and no patient was impaired at all tasks. Overall, this dataset provides support for 'fractionated' views of frontal lobe function, and clarifies the behavioural and anatomical selectivity of a set of widely used tests of executive function.

B112

A COMPLEMENTARY APPROACH TO IMPULSIVITY IN ADHD USING A TIME PERCEPTION TASK Kazufumi Omura[1], Nami Okada[1]; [1]Faculty of Education, Art and Science, Yamagata University — Previous research has contributed to the understanding of impairments in behavioral inhibition (impulsivity) in patients with attention-deficit/hyperactivity disorder (ADHD). It is suggested that time perception may be related to impulsiveness. The internal clocks of impulsive individuals may run faster than those of non-impulsive individuals. An impulsive individual would be likely to overestimate time intervals. This study evaluated how individual differences in the time perception correlate with the impulsive traits measured by simple behavioral experiments and self-reported questionnaires. Twenty-six healthy participants completed self-reported impulsivity measure, Barratt Impulsiveness Scale, version 11 (BIS-11, three components of impulsivity: motor, cognitive, and attentional). Afterwards, they were asked to perform two behavioral tasks, a time perception task and a stop-signal task. In the time perception task, participants estimated time interval (15 s) during seeing a fixation on a computer screen and press the button when they thought the number of seconds had passed. In the stop-signal task, participants inhibited to press the button if a stop signal appears after the onset of go signal. Reaction time and responses were recorded and analyzed. Faster participants' time estimation was found to be related to significantly higher score of their BIS-11 motor-impulsivity. Strangely, there were no significant correlations between the score of the stop-signal task and any subsets of BIS-11. The results suggest that time perception task to be a potential tool to the complementary nature of self-report questionnaires and neuropsychological tasks in the assessment of impulsivity in ADHD.

B113

IMPROVED CONTROL OVER BRAIN REGIONS USING META-COGNITIVE AWARENESS: FUNCTIONAL CONNECTIVITY CHANGES UNDERLYING IMPROVED SELF-REGULATION OF RLPFC Matthew Dixon[1], R. Graeme McCaig[1], Kalina Christoff[1]; [1]University of British Columbia — Real-time fMRI (rt-fMRI) has allowed for the possibility of training subjects to control localized brain activation. While rt-fMRI studies have mainly focused on changes in an isolated target region of interest, it is likely that learning to control activation in a given brain area is instantiated by changes across a network of regions. We previously reported that a real-time feedback group, but not a sham feedback group, learned to regulate activation in rostrolateral prefrontal cortex (RLPFC) through use of meta-cognitive awareness. Here we sought to provide first examination of changes in the strength of functional connectivity during the course of real-time training using RLPFC as a seed region. Several regions including the bilateral inferior parietal lobule, posterior cingulate/retrosplenial cortex, and right inferior frontal gyrus exhibited a linear increase in functional connectivity with the RLPFC across training sessions and this effect was significantly greater in the real-time feedback group. Additionally, the dorsal anterior cingulate cortex and the inferior frontal junction (and the ventral striatum at a liberal threshold) displayed greater functional connectivity with the RLPFC in the real-time relative to the sham group across all training sessions. Improved control over RLPFC activation and sustained meta-cognitive awareness was associated with enhanced functional connectivity between RLPFC and a distributed network of areas supporting internal experience, executive control, and reinforcement learning. These findings highlight the importance of considering network mechanisms in learning to control localized brain activation and open the possibility of using rt-fMRI training to alter large-scale functional networks of the brain.

B114

ELECTROPHYSIOLOGY OF NUMBER COMPARISON IN 6-7 YEAR-OLD CHILDREN Nadia Nosworthy[1], Matt Waxer[1], Daniel Ansari[1]; [1]The University of Western Ontario — A large body of research has demonstrated that numerical magnitude processing is important for children's development of mathematical skills. Significantly less is known about the neural representation of numerical magnitude and how this changes as a function of development and learning. In the present study we examined the brain responses during numerical magnitude processing in a group of children who are at the beginning of formal math instructions. Specifically, we used event-related brain potentials (ERPs) to measure the time course of brain activation during numerical magnitude comparison. We used the numerical distance effect (NDE) to measure the effect of numerical magnitude on ERP responses. The NDE is characterized by an inverse relationship between reaction times and numerical difference. Behavioral research has demonstrated that this effect changes over developmental time and previous research using ERPs in adults and five-year-old children has revealed an NDE on ERP responses. However, there currently exists no research of this kind for children who are just beginning formal math education and arithmetic learning. To address this question, we examined the neural correlates of numerical magnitude comparison in first and second grade students. Seventeen 6-7 year-olds completed a numerical comparison task while wearing a 128-channel geodesic sensor net. Consistent with previous research, a significant main effect of distance was found on the transition between the N1 and P2p components over parietal electrode sites. Age-related differences in ERP responses as well as relationships between individual differences in mathematical achievement and brain responses will be discussed.

B115

CONNECTIVITY-BASED PARCELLATION OF HUMAN PARIETAL AND DORSAL PREFRONTAL CORTICES Jerome Sallet[1,2], Rogier Mars[1,2], Saad Jbabdi[2], Timothy Behrens[2], Heidi Johansen-Berg[2], Matthew Rushworth[1,2]; [1]Decision and Action Laboratory, University of Oxford, [2]Oxford Centre for Functional Magnetic Resonance Imaging of the Brain, John Radcliffe Hospital, University of Oxford — Surprisingly we do not much about the structural connectivity of the human brain, even though regions connections to the rest of the brain strongly constrain its functions. Our knowledge of human brain organization is principally based on its cytoarchitecture and on inferences from neuro-anatomical studies in non human primates and rodents. Recent developments of Diffusion Tensor Imaging (DTI) tools enable now to study the connectivity of the human brain. In this experiment, DTI was used to investigate connectivity profiles of dorsal prefrontal and parietal cortices. First, an algorithm was used to search for regional variations in the probabilistic connectivity profiles of all prefrontal and parietal cortex voxels with the whole of the rest of the brain. The results of this analysis were submitted to a clustering algorithm to determine clusters that slow similar connectivity profiles. Second, the probabilities of connection between identified clusters and predefined target regions of interest were calculated, such as to determine a connectivity fingerprint for each region. Preliminary results suggest a consistent clustering across subjects that fairly seems to follow known cytoarchitectonic differences. These preliminary results suggest in the parietal cortex a rostro-caudal organization of IPL and SPL. In the dorsal prefrontal cortex, they suggest a dorso-ventral and rostro-caudal segregations of clusters. These later results of the parcellation analysis will be discussed in regards to the theory of the functional hierarchical organization of the dorsolateral prefrontal.

B116

ERP VOLTAGE MAPPING AND SURFACE LAPLACIAN MEASURES MEDIATE OBSERVED GENETIC INFLUENCES ON EARLY AND LATE PROCESSING IN A VISUAL ODDBALL TASK Lauren E. Ethridge[1], Stephen M. Malone[2], William G. Iacono[2], Brett A. Clementz[1]; [1]University of Georgia, [2]University of Minnesota — Studying genetic influences on complex cognitive operations provides an opportunity to understand the extent to which constitutional and environmental factors uniquely contribute to individual differences in problem-solving abilities. Monozygotic (MZ or identical) twins share all of their genes, while dizygotic (DZ or fraternal) twins share only about 50 percent of them. An increased similarity between MZ compared to DZ twins for a particular trait should be due to genes rather than shared environment. Neuroimaging studies (fMRI and/or EEG/MEG studies in which data are analyzed in source space) of normal twins performing complex cognitive operations are surprisingly rare. In the present project, subjects were required to detect infrequent target stimuli within the context of frequently presented nontarget, or standard, stimuli. N170 and P300 components in the target condition showed moderate to high levels of heritability when measured with scalp potentials alone, but reduced heritability when measured at the level of approximate sources using surface laplacian mapping. The P250 component associated with the target condition showed the opposite effects, while the nontarget-associated late slow wave component showed similar levels of heritability for both voltage and surface laplacian measures. Results suggest that observed genetic influence on brain activity may be dependent on method of measurement: global (voltage) versus more localized (surface laplacian). Traditional additive and dominance (ADE) models were tested for all peaks, however intraclass correlation values suggest that emergenic rather than additive genetic effects may be indicated for a subset of these components.

B118

SUBCORTICAL AND COGNITIVE DEFICITS IN 1991 GULF WAR SYNDROME 2 Kimberly Case[1], Ilana Levy[1], Kaundinya Gopinath[2], Jeffrey Spence[2], Kristin Moffett[1], Parina Gandhi[2], Aman Goyal[2], Yan Fang[2], Richard Briggs[2], John Hart[2], Anna Moore[3], Bruce Crosson[1]; [1]University of Florida, [2]University of Texas Southwestern Medical Center, [3]Emory University School of Medicine — About 26-32% of 1991 Gulf War veterans have multiple symptoms not explained by post-traumatic-stress disorder, collectively known as Gulf War Syndrome (GWS). One group of studies divided GWS into 3 syndrome groups with syndrome 2 (GWS 2) showing the most marked cognitive deficits. GWS 2 patients have been found to have dysfunction of the basal ganglia (BG) possibly due to sarin exposure. Ten GWS 2 patients (53-71yrs) and twelve healthy deployed controls (51-76yrs) performed a blocked word-generation fMRI task. Participants were given category cues and asked to covertly generate category members for 15 seconds. The analysis of fMRI BOLD signal incorporated recently developed statistical methodology that accounts for the spatial correlation among voxels. Clusters of contiguous voxels were defined based on regional spatial models, and local signal was estimated by spatial averages within clusters. Using this method, the GWS 2 patients had significantly less activity in the BG, thalamus, and other subcortical regions than healthy control veterans. Participants also completed a battery of language-related tests showing that GWS 2 patients had lower scores on phonemic fluency (DKEFS) and a semantic working memory task. These results emphasize the cognitive deficits of GWS 2 patients and the importance of further research in understanding GWS 2 and the other Gulf War Syndromes groups. These findings also demonstrate how basal ganglia dysfunction can account for cognitive performance in GWS 2 patients.

B119

SELECTION AND CONTROLLED RETRIEVAL: SHARED NEURAL SUBSTRATES, DIFFERENTIAL MODULATION BY ANXIETY AND DEPRESSION Hannah R. Snyder[1], Marie T. Banich[1], Yuko Munakata[1]; [1]University of Colorado at Boulder — During language production, words must constantly be retrieved and selected for production in the face of many possible alternatives. Multiple lines of evidence indicate the importance of left ventrolateral prefrontal cortex (VLPFC) in this process, but its exact role is debated: (1) selection between multiple automatically-activated representations (e.g. Thompson-Schill et al., 1997), (2) controlled retrieval from semantic memory when a response is not automatically activated (e.g. Martin & Cheng, 2006), or, (3) selection in mid-VLPFC and retrieval in anterior-VLPFC (e.g. Badre & Wagner, 2007). Previous research used correlated measures of selection and retrieval demands, making it difficult to adjudicate between these competing hypotheses. We use unconfounded measures and independently manipulate selection and retrieval demands in a verb generation task, showing shared neural substrates support these processes, including left anterior and mid-VLPFC and posterior anterior cingulate/pre-supplementary motor area (pACC/pre-SMA). Moreover, selection and retrieval interact in left VLPFC: selection effects are stronger when retrieval demands are low. These results are contrary to previous accounts positing a single role for left VLPFC or a functional dissociation between anterior and mid VLPFC. Rather, we suggest that two properties of PFC, competitive inhibition and recurrent connectivity, respectively support selection and retrieval within in the same cortical areas. While shared neural substrates subserve selection and retrieval, they are differentially modulated by psychopathology: anxiety affects VLPFC activity during selection while depression affects pACC/pre-SMA during retrieval. Implications for models of cognitive control during language production, and cognitive control deficits in anxiety and depression, are discussed.

B120

COGNITIVE ASSESSMENT AND QUANTITATIVE IMAGING IN SYSTEMIC LUPUS ERYTHEMATOSUS Becky Haynes[1], Kevin Davies[1], Nicholas Dowell[1], Paul Tofts[1], Jenny Rusted[2]; [1]Brighton and Sussex Medical School, [2]The University of Sussex — This study investigates cognition in Systemic Lupus Erythematosus (SLE) and aims to relate this to quantitative brain imaging. Whereas other imaging studies have focused on a single metric of cognitive impairment this study focuses on separate aspects of cognition. Patients (mean age 41±8.6) with a primary diagnosis of SLE were compared to matched controls. Participants completed a broad cognitive test battery, psychological measures and quantitative MRI using magnetisation transfer and diffusion tensor imaging (DTI). From DTI we can measure the extent (ADC) and directionality (FA) of diffusion which are sensitive measures of brain structural integrity. Initial results indicate that across the battery the patient group performed worse than controls. Significant differences emerged on episodic memory (AVLT), simple speed of processing tasks and fluency tasks. On the AVLT the patients had lower baseline recall scores, but comparable rates of learning to controls. Controls showed more proactive interference, whereas the patients showed greater retroactive interference. SLE patients have previously showed some speed of processing deficits. In this study deficits were evident on pencil-and-paper tasks, with no difference on computerised ones, suggesting perhaps motor problems (moderate correlation between finger tapping and digit symbol copying) or motivation issues. On DTI measures the patient group showed increased ADC and decreased FA in the white matter, changes which are consistent with subtle brain damage. Future work will involve relating these changes to the cognitive deficits identified and how these differences relate to neuropsychiatric manifestations in these patients.

B121

THE BAYCREST PSYCHOSOCIAL STRESS TEST: A NEW PARADIGM ALLOWING FOR THE ASSESSMENT OF IN VIVO COPING BEHAVIOUR FOLLOWING TRAUMATIC BRAIN INJURY Katherine Krpan[1,2], Donald Stuss[1,3], Nicole Anderson[1,2]; [1]University of Toronto, [2]Kunin-Lunenfeld Applied Research Unit, Baycrest, [3]Rotman Research Institute, Baycrest — Coping has been hypothesized to be the final common pathway leading to negative outcomes following traumatic brain injury (TBI). The mechanisms of this relationship, however, are unclear. Prior research in this area has almost exclusively depended upon self-reported coping. These measures are particularly problematic following TBI given the known impairments in self-awareness and memory. The purpose of this study was to assess coping behaviour during a simulated real world stress test that we developed, the 'Baycrest Psychosocial Stress Test', and to relate behaviour to neuropsychological performance. People with TBI and matched controls completed a neuropsychological test battery, the Ways of Coping (WOC) Questionnaire, and were asked to give an impromptu speech about crime in Toronto to a confederate posing as a specialist in communications. Between task instructions and speech delivery, participants were left alone for 10 minutes with a number of materials that facilitated either planful or avoidant coping. Behaviour was recorded and later coded by three independent blinded raters. There were no differences between groups in self-reported coping on the WOC. However, the control group engaged in more planful than avoidant coping, while the TBI group engaged in more avoidant than planful coping. Moreover, based on behaviour, the TBI group could be divided into 'planners' and 'avoiders', and varied on a number of neuropsychological variables including executive function and premorbid intelligence. Results suggest that the BPST may be sensitive to differences in coping that are not evident on self-report measures, and that these differences are related to neuropsychological function.

B122

REPRODUCIBILITY OF FMRI BOLD SIGNAL IN THE COGNITIVE CONTROL NETWORK IN THE STROOP PARADIGM Raymond Cho[1], Tetsuya Takahashi[1], Rupa Ramaswamy[1], Cameron Carter[2], Jonathan Cohen[3]; [1]University of Pittsburgh, [2]UC Davis, [3]Princeton University — Functional MRI (fMRI) has been one of the primary tools for study the neural bases of cognitive processes. However, the large variability in the fMRI blood oxygenation level dependent (BOLD) signal can pose a challenge when making comparisons between groups or across time. There has been relatively little work regarding the reproducibility of BOLD signal modulations as elicited by cognitive tasks. We investigated test-retest reliability of BOLD activations in the dorsoloateral prefrontal cortex (DLPFC) and anterior cingulated cortex (ACC) regions in 15 healthy control subjects performing a fast event-related version of the Stroop task in two separate sessions. Regions of interest (ROI) were defined by main effects of condition in two separate ANOVA models, one contrasting Incongruent and Congruent trials (Contrast 1) and the other contrasting Error and Correct (Contrast 2) trials. Both contrasts gave rise to highly robust ROIs in the DLPFC and ACC regions, with no main effect of Session or Condition by Session interaction, indicating an overall stability of the activations. Intraclass correlation coefficients (ICCs) were calculated for each Contrast in each ROI. Significant, moderate ICCs were observed for the DLPFC (Contrast 1) and ACC (Contrast 2) with poorer ICCs for the other indices. These findings indicate that even higher cognitive processes such as those tapped in cognitive control paradigms such as the Stroop task can elicit fMRI BOLD signals that have a relatively high degree of reproducibility.

B123

EFFECT OF LEVODOPA MEDICATION ON IMPLICIT SEQUENCE LEARNING IN PARKINSON'S DISEASE Mazda Beigi[1,2], Leonora Wilkinson[1], Andrew Parton[2], Marjan Jahanshahi[1]; [1]Institute of Neurology, [2]Brunel University — Introduction: 11C-raclopride PET imaging has shown that in healthy individuals sequence learning on the serial reaction time task (SRT) is associated with release of endogenous dopamine in the striatum. Tonic increase of dopamine with levodopa medication has been proposed to mask phasic changes in dopamine necessary for learning. In light of these, our aim was to investigate how levodopa medication affects implicit sequence learning on a probabilistic SRT in Parkinson's disease. Method: Nine patients with Parkinson's disease (mean age 66.1, 11 male) with mild to moderate illness were tested on two separate days with a minimum interval of a week, once on medication and once off medication (overnight withdrawal for mean of 11.3 hours (SD=1.6). We used 15 blocks of 100 trials of a probabilistic (85% probable and 15% improbable targets) SRT. Parallel second order conditional 12 item sequences were used for training on and off medication, with order counterbalanced. Results: Preliminary results suggest that implicit sequence on the probabilistic SRT is somewhat better on than off medication; although the sample size needs to be increased. Conclusion: Preliminary results are consistent with previous findings that functions mediated by motor and associative fronto-striatal circuits are improved with levodopa medication in PD.

B124

PERCEPTUAL AMBIGUITY DRIVES SUBJECTIVE DECISION COSTS: A TEST OF NEURAL MEDIATION Joseph McGuire[1], Matthew Botvinick[1]; [1]Princeton University — Decision-making under conditions of ambiguous or conflicting evidence can carry intrinsic costs. Decision costs can lead people to avoid or defer decisions, or alternatively to adopt simplifying strategies. The mechanisms through which information processing demands give rise to decision costs are poorly understood. Participants in the present fMRI experiment made simple motion-direction decisions about stimuli that varied in their perceptual difficulty (i.e., noise vs. coherence). Participants were periodically permitted to escape their current difficulty level, and opted to escape more frequently when perceptual difficulty was greater. Analyses tested for neural regions that were candidates to mediate the influence of perceptual difficulty on escape. Whole-brain, within-subject mediation analyses revealed that activity in dorsomedial prefrontal cortex and in anterior areas of the basal ganglia showed statistical covariance patterns characteristic of mediation. In basal ganglia the mediating response was negative: greater perceptual noise elicited reduced BOLD response, which in turn predicted decisions to escape the task. In dorsomedial prefrontal cortex, conversely, the mediating response was positive. Processes subserved by the identified brain regions may account for decision costs by effecting a transformation between decision difficulty and reduced valuation. Results offer insight to the origin of subjective decision costs under conditions of ambiguous perceptual evidence.

B125

COVERT COUNTERMEASURES DISRUPT FMRI-BASED DECEPTION DETECTION Giorgio Ganis[1,2,3]; [1]Harvard Medical School, Boston, MA, [2]Massachusetts General Hospital, Charlestown, MA, [3]Harvard University, Cambridge, MA — Functional magnetic resonance imaging (fMRI) studies have documented differences between deceptive and honest responses. Capitalizing on this research, companies marketing fMRI-based lie detection services have been founded, generating ethical concerns. Critically, no fMRI study has examined directly the effect of countermeasures, methods used by prevaricators to defeat traditional deception detection procedures. An fMRI study was conducted to fill this research gap using a concealed information paradigm. In one condition, participants were trained to use a covert countermeasure, whereas in a second condition they performed the task without using countermeasures. Robust group fMRI differences between deceptive and honest responses were found only in the no-countermeasure condition. Furthermore, in single participants, deception detection accuracy was 100% without countermeasures, based on activation in medial and ventrolateral prefrontal cortices, but fell to 33% with countermeasures. These findings clearly demonstrate that fMRI-based deception detection measures are vulnerable to countermeasures. Importantly, they underscore the pressing need for more basic science research before these methods can be applied in real life settings.

B126

SELECTIVE ROLE OF THE ANTERIOR CINGULATE CORTEX IN FEEDBACK EVALUATION Celine Amiez[1], Jerome Sallet[2], Emmanuel Procyk[3], Michael Petrides[1]; [1]McGill University, Montréal Neurological Institute, Neuropsychology/Cognitive Neuroscience, Montréal, Canada, [2]University of Oxford, UK, [3]INSERM U846, Stem Cell and Brain Research Institute, Bron, France — Learning is affected by outcome expectations and the detection and utilization of actual outcomes (positive and negative). In primates, this function is known to involve the anterior cingulate cortex (ACC). On one hand, several studies have shown that neuronal activity in the anterior cingulate cortex specifically encodes negative feedback signaling incorrect trials. On the other hand, recent studies have suggested that the role of this region may not only be restricted to error processing, but may also extend to the encoding of positive feedback. The present study examined whether the ACC is involved in the evaluation and utilization of both negative and positive outcomes of goal directed actions. We used functional magnetic resonance imaging to demonstrate the involvement of the ACC in tracking the value of both negative and positive feedback during trial and error learning. Normal human subjects (N=11) were scanned in a 1.5T scanner while performing a problem-solving task in which they had to discover by trial and error which one of four identical stimuli was associated with positive feedback. ACC feedback-related activity was modulated by prediction errors, i.e. the difference between the expected and the obtained feedback. These results therefore demonstrate that the ACC is involved in evaluating positive or negative outcomes that carry information for adaptive behavior, such as maintaining exploration after errors (negative feedback) or shifting towards exploitation following the occurrence of a correct response (positive feedback).

Attention: Spatial

C1

AGE-RELATED CHANGES IN THE ATTENTIONAL CONTROL OF VISUAL CORTEX: A SELECTIVE PROBLEM IN THE LEFT VISUAL HEMIFIELD Lindsay Nagamatsu[1], Patrick Carolan[1], Teresa Liu-Ambrose[1], Todd Handy[1]; [1]The University of British Columbia — To what extent does our visual-spatial attention change with age? While it has been previously reported that relative to young controls, seniors show delays in attention-related sensory processing, it remains unclear whether these differences are due to deficits associated with the sensory benefits of attention, or whether the generation of control signals to begin with are impaired. Therefore, our study reported here examined both attentional control and attentional facilitation using a basic cueing paradigm in seniors (aged 66 to 74 years) and undergraduate students (aged 18 to 25 years). Participants responded to peripheral targets that were either cued or uncued by a central, predictive arrow. Both behavioural and electrophysiological data were collected, via reaction times and event-related potentials (ERPs) respectively. Results indicate that compared to young controls, seniors have delayed attentional facilitation in sensory processing in the left visual field, as indexed by the lateral occipital P1 ERP component. Additionally, we found an attenuated attentional control response in the left visual field of seniors, as measured by the anterior-directing attentional negativity (ADAN) ERP component. Based on our results, we conclude that within controlled, top-down attentional orienting, there are impairments in two separate aspects of the system in seniors: both the act of orienting and changes in sensory gain that result from attention. These results can be interpreted as suggesting that seniors have problems with both the orienting and reorienting of attention, and that the underlying cause of these problems may stem from right-hemisphere specific deterioration.

C2

CORTICAL GAMMA-OSCILLATIONS MODULATED BY VISUOMOTOR TASKS -INTRACRANIAL RECORDING IN PATIENTS WITH EPILEPSY Eishi Asano[1], Tetsuro Nagasawa[1], Robert Rothermel[1], Csaba Juhasz[1], Masaaki Nishida[1], Sandeep Sood[1]; [1]Children's Hospital of Michigan, Wayne State University — A number of human studies using intracranial electrocorticography (ECoG) have shown that visually-cued movements elicit augmentation of gamma-oscillations in the Rolandic area. In the present study of children with focal epilepsy who underwent epilepsy surgery, we determined how visuomotor tasks modulated gamma-oscillations in the posterior head region as well as Rolandic area. Each visual-cue consisted of either a sentence or hand gesture instructing the subject to press or not to press the button. Regardless of the recorded hemisphere, viewing sentence and gesture cues elicited gamma-augmentation sequentially in the lateral-polar occipital and inferior occipital-temporal areas; subsequently, button-press movement elicited gamma-augmentation in the Rolandic area. The magnitudes of event-related gamma-augmentation in the Rolandic and inferior occipital-temporal areas were larger when the hand contralateral to the recorded hemisphere was used for motor responses. A double dissociation was found in the left inferior occipital-temporal cortex in one subject; the lateral portion had greater gamma-augmentation elicited by a sentence-cue, whereas the medial portion had greater gamma-augmentation elicited by a gesture-cue. Sensorimotor attention to one side of the hand may enhance connectivity in the contralateral hemisphere between the primary sensorimotor and ventral visual areas. The present study demonstrates the presence of two distinct ventral visual pathways participating in processing of sentence and gesture cues in an epileptic patient.

C3

LARGELY OVERLAPPING NETWORKS MEDIATING ATTENTIONAL CONTROL DURING SPATIAL AND OBJECT-BASED ATTENTION Christian Stoppel[1], Hendrik Strumpf[1], Jens-Max Hopf[1,2], Hans-Jochen Heinze[1,2], Mircea Ariel Schoenfeld[1,2,3]; [1]Centre for Advanced Imaging, Otto-von-Guericke-University, Magdeburg, Germany, [2]Leibniz-Institute for Neurobiology, Magdeburg, Germany, [3]Kliniken Schmieder, Allensbach, Germany — Visual attention can be shifted between spatial locations, single features or objects. These shifts are under control of a network of frontal and parietal areas. The current study employed fMRI to investigate the neural correlates of attentional control during voluntary and stimulus-driven attentional shifts between locations and objects. Subjects were presented with two apertures located in the left and right visual field, with two overlapping transparent surfaces continuously moving into opposite horizontal (left aperture) and vertical (right aperture) directions. They were cued to attend one of the two transparent surfaces at one spatial location and pressed a button on the occurrence of a fast movement in the predominant movement direction of that attended surface. On specific direction-combinations of two short subsequent displacements of the attended surface the subjects either maintained their attention at the same surface, switched to the other surface within the same aperture or switched to the other aperture to one specific surface at that location. In addition fast movements also occurred within the non-attended surfaces thereby capturing the subjects' attention. After extensive practice 18 subjects participated in the study. The results demonstrate that attentional maintenance and different attentional shifts (endogenous/exogenous and spatial/object-based) recruit a largely-overlapping fronto-parietal network, in which modulations only differed in magnitude across conditions. Our data support the notion that attentional control is executed by one domain-general cortical network.

C4

RESPONSE PROFILES OF MACAQUE DLPFC NEURONS DURING TARGET SELECTION AND SUSTAINED ATTENTION Therese Lennert[1], Julio C. Martinez-Trujillo[1]; [1]McGill University, Montréal, Canada — The dorsolateral prefrontal cortex (dlPFC) has been proposed as a source of attentional control signals in the primate brain. To investigate this issue we recorded single-cell activity in dlPFC and visual area MT of two macaques during the following task. During a trial an animal was presented with two differently colored moving random dot patterns (RDPs) left and right of a central fixation spot. According to a color selection rule the animal selected one RDP as the target, sustain attention to it, and detected a transient change in its motion direction. From 222 dlPFC neurons, 61% showed task-related activity. Out of these, 68% reliably encoded the position of the attended target (attention neurons). These were subdivided into three distinct populations: one group encoding target position transiently, starting ~150ms after color cue onset (21%, 'selection neurons'), a second group signaled target position in a sustained manner, starting ~350 ms after cue onset (42%, sustained attention neurons), and the third group combined features of the aforementioned groups (37%). Analysis of MT responses revealed that neurons encoded target position starting ~400 ms after cue onset, similarly as the dlPFC sustained attention neurons. Our data indicate that different populations of dlPFC neurons may be involved in the selection and sustained enhancement of target signals. Once the target has been spatially selected by selection neurons, sustained attention neurons may send feedback signals to visual area MT enhancing the processing of visual features at the attended location.

C5

EVENT-RELATED BRAIN POTENTIALS REVEAL EVIDENCE FOR WITHIN-CATEGORY COMPETITION FOR VISUAL REPRESENTATION Paul Corballis[1], Robert Starling[1], Matthew Hilimire[1], Nathan Parks[2]; [1]Georgia Institute of Technology, [2]University of Illinois at Urbana-Champaign — The biased competition theory of visual attention holds that stimuli compete for representation within the visual system. According to this account, competition arises primarily in the extrastriate visual cortex, and occurs when two or more objects are presented within the same receptive field. In this study, we sought an event-related potential (ERP) correlate of competition in the human visual system. We capitalized on the extensive literature indicating that separate populations of neurons respond strongly to images depicting human faces (e.g., the fusiform face area, FFA) and houses (the parahippocampal place area, PPA), and that these areas have large receptive fields. In two conditions we recorded ERPs while subjects monitored a stream of centrally-presented stimuli (either faces or house images) for rare inverted images. The central stimuli were flanked by pairs of faces, houses, or phase-scrambled images. We reasoned that flanking faces would compete for representation with other faces but not with houses, and likewise that flanking houses would compete with houses but not faces. Phase-scrambled flankers were included as a low-level control. In the "face" condition the N170 component of the ERP was attenuated when the flanking stimuli were faces compared to houses or scrambled faces. Similarly in the "house" condition the N1 component was reduced in amplitude when the flanking stimuli were houses compared to faces or scrambled houses. These results are consistent with predictions derived from the biased competition theory that there should be more competition between stimuli from the same perceptual category than from different categories.

C6

TARGET LIKELIHOOD AND ERP CORRELATES OF A LARGE SET-SIZE VISUAL SEARCH TASK Barry Haimson[1], Meghan Brouillard[1], Andrea Shafer[2], Eric Ragusa[1], Megan Speer[1], Kristin Monteiro[1]; [1]University of Massachusetts Dartmouth, [2]Centre for Neuroscience, University of Alberta — Previous researchers have reported that visual search (VS) tasks with large set-sizes and high distracter homogeneity are grouped together and are processed globally while VS tasks with small set-sizes are processed locally. The purpose of the present study was to further clarify the factors contributing to the processing of targets embedded in a large set of distracters by varying the likelihood of the target. ERP activity was obtained while participants viewed a series of displays consisting of a 11 X 11 matrix of white lines on a black background. Distracter displays consisted of homogeneous lines tilted at a 45 degree angle to the left or right. Target displays contained one line that was tilted 45 degrees in the direction opposite to the distracters. The target randomly appeared on either 50 or 20 percent of the trials at two locations in either the left visual field (LVF) or the right visual field (RVF). Peak amplitude values in the P300 window for an initial set of participants were evaluated with a 2 (Target Likelihood) X 2 (VF) repeated measures ANOVA. The results indicated a significant or close to significant Target Likelihood X VF interaction at C3, P3, Cz, and Pz. Peak amplitude values were higher for the 20-percent condition when the target was in RVF and for the 50-percent condition when the target was in the LVF. These results suggest the mode of processing in a large-set-size VS task might be influenced by target likelihood, VF, and hemispheric projections.

C7

ACTIVITY IN THE FRONTO-PARIETAL ATTENTION NETWORK REFLECTS BOTH INTERACTING AND INDEPENDENT FUNCTIONAL SUBNETWORKS: A PARTIAL LEAST SQUARES APPROACH Christine Tipper[1], Barry Giesbrecht[1], Scott Grafton[1]; [1]University of California, Santa Barbara — The instantiation of multiple cognitive processes subserving attention, such as volitional maintenance of expectancy, reflexive orienting to an unexpected target, or vigilance in the absence of an explicit cue, within a broad fronto-parietal attention network (FPN) is of considerable empirical interest. We employed a multivariate partial least squares (PLS) analysis to identify the cognitive processes involved in an attention task and their functional architecture. PLS identifies independent sources of variance that account for differences in BOLD activity between conditions, allowing patterns of brain function to emerge without the a priori theoretical constraints required in applying linear contrasts. SPM5 was used to estimate BOLD activity for 24 subjects, within six conditions: correct and incorrect responses for targets following valid, invalid, and neutral cues. Weighted beta images were submitted to PLS, and the significance of each latent variable was assessed via bootstrapping and permutation tests. The first significant variable reflected opposing influences of volitional and reflexive orienting processes within dorsal and ventral subnetworks anatomically consistent with existing research (Corbetta & Shulman, 2002). While these functions were localized to distinct anatomical regions within the FPN, their joint emergence in a single latent variable indicates that they are not functionally independent processes, but rather operate in direct opposition. The second and third variables reflected independent processes involved in expectancy violation and behavioral accuracy. The results support the view that attention-related brain activity reflects the contribution of multiple interacting and independent cognitive processes mediated by functionally distinct sub-networks of the broader FPN.

C8

FROM LOCAL INHIBITION TO LONG-RANGE INTEGRATION: A FUNCTIONAL DISSOCIATION OF ALPHA-BAND SYNCHRONIZATION ACROSS CORTICAL SCALES IN VISUOSPATIAL ATTENTION Sam Doesburg[1,2], Jessica Green[3], John McDonald[3], Lawrence Ward[1,4]; [1]University of British Columbia, [2]Child and Family Research Institute, [3]Simon Fraser University, [4]Brain Research Centre, University of British Columbia — When attention is allocated to one visual hemifield, increased alpha power is observed in ipsilateral visual cortex. This has been attributed to synchronization of alpha-band oscillations within cortical regions which reflects inhibitory processing. Recent results, however, indicate that synchronization of alpha oscillations between cortical regions is relevant for transient functional coupling. Such coupling is thought to be involved in orienting attention to a specific region of the visual field. We thus hypothesized that alpha-band synchronization between low-level visual cortex and higher-level visual brain regions would be increased in the hemisphere contralateral to an attended location. To test this hypothesis we calculated phase synchronization between attention-related EEG source activations occurring between predictive directional cues and expected visual targets. Alpha amplitude (understood as an index of local synchronization) within low-level visual cortex was increased ipsilateral to attended locations and decreased contralateral to attended locations, consistent with alpha-band scalp topography and previous research relating local alpha power to active inhibition. Increased long-range alpha-band synchronization between low-level visual cortex and parietal cortex, however, was observed contralateral to the attended visual hemifield, whereas decreased synchronization (phase scattering) was observed in the ipsilateral hemisphere. These results identify a potential mechanism for the enhanced processing of stimuli appearing at attended locations, as long-range synchronization is thought to increase the fidelity and effectiveness of communication between brain areas. Our observation of inhibitory amplitude changes, interpreted as increased local-area synchronization, and facilitatory long-range synchronization demonstrates a functional dissociation for alpha-band synchronization across cortical scales.

C9

PRISMATIC ADAPTATION IN THE THERAPY OF SPATIAL AND OBJECT NEGLECT: A CASE STUDY Anna Grzybkowska[1], Miroslaw Wyczesany[1]; [1]Jagiellonian University — The goal of the present study was to evaluate the experimental method of prismatic adaptation which can be used in the rehabilitation of patients with hemispatial neglect. Paper and pencil tests (drawing, line bisection, landmark test, Ota's tests) were used to diagnose neglect symptoms. Moreover, the computer version of Ota's tests which can diagnose spatial and object variants of neglect were applied (Ota et al., 2003). The patient who participated in the study was 71 year old man, 11 years after right hemisphere stroke. In the computer tasks he compared angles between clock hands of two clocks presented on a either left or right side of the computer screen and also had to imagine these clocks (the hours were presented only as digits). His performance after the administration of prismatic adaptation was compared to the initial performance level. The measurements were also done one hour, one week, and one month after the rehabilitation session. Summarizing, before administration of the prismatic adaptation, the patient showed symptoms of spatial neglect in the perceptual task, but not in the imagination task. These symptoms declined after prismatic adaptation. There were also no signs of spatial neglect symptoms reversion after the prolonged time. In all these measurements the patient showed no signs of spatial neglect in the imagination task, and no signs of object neglect in the perceptual and imagination tasks. The therapeutic applications of the presented method are discussed.

C10

ATTENTION BIASES THE PERCEIVED MIDPOINT IN THE BISECTION TASK IN NORMAL SUBJECTS Monica Narcisa Toba[1,2], Patrick Cavanagh[3], Paolo Bartolomeo[1,2,4,5]; [1]Université Pierre et Marie Curie-Paris6, Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, UMR-S975, Paris, France, [2]Inserm, U975 (ex-U610), Paris, France, [3]Laboratoire Psychologie de la Perception, Université Paris Descartes, Paris, France, [4]AP-HP, Pitié-Salpêtrière, Fédération de Neurologie, Paris, France, [5]Catholic University, Milan, Italy — Neglect patients demonstrate a bias in visual attention, which tends to be captured by right-sided objects. They deviate rightwards when marking the center of a horizontal line, and misjudge bisected lines with rightward-displaced centers as being symmetrical. We examined whether there was an equivalent attentional bias effect on bisection in normal subjects. We based our experiment on the attentional repulsion effect (ARE, Suzuki & Cavanagh, 1997) where the perceived location of a test is displaced away from a transient, attention-attracting cue. To test this cueing effect in bisection tasks, we presented normal participants with lines bisected either centrally or to the left or to the right of the true midpoint, preceded by lateralized cues. Subjects indicated whether they saw the bisection mark at the left or at the right of the midpoint. For each observer and experimental condition, we plotted the proportion of 'seen-at-right' responses, and fit a sigmoid curve to the data. Right-sided cues shifted the apparent bisection point to the left (and vice versa), as predicted by the ARE. Specifically, the cue-induced attention repels the perceived location of the bisection marker away from the attentional focus so subjects required the mark to be nearer to the attentional focus to be judged as lying at the midpoint. These results obtained in normal subjects by manipulating the transient component of attention are similar to the behavioral pattern exhibited by neglect patients, suggesting that their sustained attentional bias contributes to the classic bisection errors of neglect.

C11

ADAPTATION TO LEFTWARD-SHIFTING PRISMS REDUCES THE GLOBAL PROCESSING BIAS OF HEALTHY INDIVIDUALS Janet Bultitude[1], Jill Woods[1]; [1]School of Psychology, Bangor Univeristy, UK — When healthy individuals are presented with figures in which small letters are arranged to form a large letter, they are faster to identify the global than local level information, and have difficulty ignoring global information when identifying the local level. The global reaction time advantage and global interference effects imply biased processing of global information in the normal brain. This contrasts with the local processing bias demonstrated following lesions to the right temporo-parietal junction (TPJ), such as those that lead to hemispatial neglect. Recently, we demonstrated that adaptation to rightward-shifting prisms, which ameliorates many leftward performance deficits of neglect patients, improved the local processing bias of patients with right TPJ lesions (Bultitude, Rafal & List, 2009). Here we demonstrate that adaptation to leftward-shifting prisms, which can induce neglect-like performance in healthy individuals, also reduces the normal global processing bias. Forty-eight healthy participants identified the global or local forms of hierarchical figures before and after adaptation to leftward- or rightward-shifting prisms. Prior to prism adaptation, both groups had greater difficulty ignoring irrelevant global information when identifying the local level (global interference) compared to their ability to ignore irrelevant local level information when identifying the global level (local interference). Participants who adapted to leftward-shifting prisms showed a significant reduction in global interference, but there was no change in the performance of the rightward-shifting prism group. These results demonstrate, for the first time, that in addition to previously-demonstrated effects on lateralised attention, prism adaptation can influence non-lateralised spatial attention in healthy individuals.

C12

EFFECTS OF TASK DEMANDS ON TACTILE SPATIAL ATTENTION Elena Gherri[1], Bettina Forster[1]; [1]City University — Previous event-related-potential studies have demonstrated that the attentional modulations of early visual components are different in discrimination and detection tasks. While enhanced P1 components were present in both tasks, enhanced N1 components to valid stimuli were found only in the discrimination task, suggesting that the later N1 modulation might be related to in-depth target processing (e.g. Mangun & Hillyard, 1991). The aim of the present study was to test whether an analogous dissociation would be found for the tactile modality. Participants were instructed to endogenously shift their tactile attention to the left or right hand as indicated by a bilateral tactile cue. After a 1000 ms interval one of two different targets (high and low frequency vibrations) was presented to the cued (80%) or the uncued hand (20%). Participants vocally responded upon target presentation regardless of target type (detection task) or selected one of two vocal responses according to target frequency (discrimination task). A similar cuing effect emerged for vocal responses in both tasks with faster responses for valid than invalid trials. ERP results revealed that an enhanced N140 was elicited by valid compared to invalid targets in the discrimination task. In contrast, in the detection task an enhanced positivity was found in the P100 time range. Our results demonstrate that also in the tactile modality attentional ERP modulations depend on the specific cognitive requirement of the task. However, the pattern of modulations is qualitatively different to that reported in vision suggesting different underlying brain mechanisms in these tasks.

C13

MANUAL AND SACCADIC INHIBITION OF RETURN IN VISUAL NEGLECT Alexia Bourgeois[1], Ana Chica[1], Paolo Bartolomeo[1]; [1]Inserm U975 — When two consecutive events appear at the same spatial location, responses to the second event are slower than when the two events occur at different spatial locations. This effect, known as Inhibition Of Return (IOR) reflects a bias to preferentially attend to novel locations, necessary to explore our environment efficiently. Patients with right brain damage and left visual neglect explore their environment asymmetrically, with a bias towards processing right-sided stimuli more efficiently than left-sided ones. Here we investigated the IOR phenomenon for manual and saccadic responses in neglect patients. Our results demonstrated an abnormal facilitation, instead of IOR, for repeated right-sided events, with manual responses. However, saccadic IOR for the same stimuli was preserved. This dissociation can result from the fact that manual and saccadic IOR involve distinct neural substrates, with parieto-frontal networks (which are dysfunctional in neglect) implicated in manual IOR and subcortical structures in saccadic IOR.

C14

MAGNOCELLULAR AND PARVOCELLULAR INFLUENCES ON REFLEXIVE ATTENTION Anthony Ries[1], Joseph Hopfinger[2]; [1]Army Research Laboratory, [2]University of North Carolina — There is currently disagreement regarding the stimulus features capable of triggering a reflexive shift of attention. One theory posits that features activating the magnocellular (M) visual stream (e.g., abruptly appearing objects with luminance contrast and low spatial frequencies) are responsible for activating the reflexive attention system (e.g. Steinman et al., 1997; Yantis and Egeth, 1997). However, recent experiments suggest stimuli predominantly activating the parvocellular (P) stream (e.g., isoluminant colors with high spatial frequencies) may be at least equally important for initiating reflexive shifts of attention (e.g. Lu, 2006; Yeshurun, 2004). Using behavioral and event-related potential (ERP) measures, we tested whether differentially stimulating the M versus the P pathway triggers the same reflexive attention mechanisms, or if mechanisms of attentional capture are engaged differently depending on M or P activation. Our findings provide new evidence that both systems are capable of triggering reflexive attention mechanisms that enhance visual processing as early as the extrastriate generated P1 component of the ERP, when the inter-stimulus interval (ISI) is short. However, at long ISIs where inhibition of return (IOR) typically occurs, we found differences at later stages of processing. Our results show that the M and P visual processing streams engage similar reflexive attention mechanisms.

C15

MIND WANDERING PREFERENTIALLY ATTENUATES SENSORY PROCESSING IN THE LEFT VISUAL FIELD Julia Kam[1], Camila Fujiwara[1], Todd Handy[1]; [1]University of British Columbia — An emerging theory in visual attention is that it operates in parallel at two distinct timescales – a shorter one associated with moment-to-moment orienting of selective visual spatial attention, and a longer one (>10s) associated with more global aspects of attention-to-task. Our question is whether this slower fluctuation in task-related attention biases the same mechanism of early attentional selection as selective attention. Given that past studies have consistently revealed visual field asymmetries in selective attention, with a right visual field advantage in attentional orienting, the objective of the present study was to determine whether sensory processing in the two visual fields is differentially modulated by whether or not one is paying attention to the current task. Participants performed a simple target detection task at fixation while event-related potentials to (ERP) to task-irrelevant visual probes presented in the left and right visual fields were recorded. At random intervals, participants were asked to report whether they were "on-task" or "mind wandering". Our results demonstrated that sensory attenuation during periods of "mind wandering" relative to "on-task", as measured by the visual P1 ERP component, was only observed in the left visual field. Alternatively, the magnitude of sensory responses in the right visual field was insensitive to the two different attentional states. Taken together, our results point to a visual field difference in task-related attention, one that mirrors asymmetry found in selective visual attention.

C16

ANTICIPATED REWARD CAN REDUCE SPATIAL NEGLECT Paresh Malhotra[1], David Soto[1], Charlotte Russell[2]; [1]Imperial College London, [2]Brunel University, West London — There has been a great deal of recent scientific interest in the neural systems underpinning motivation and reward. Investigators have begun to show that reward can modulate attention in healthy individuals, with a number of brain regions being implicated in this interplay between motivational and attentional networks. To ascertain whether reward can modulate cognitive function in patients with focal brain damage, we examined the effects of anticipated monetary incentives on impaired attention in individuals with right hemisphere damage and chronic spatial neglect. Patients with right-sided stroke were assessed on a number of occasions using search and extinction tasks under three conditions: no reward, low reward, and high reward. Increased anticipated reward significantly improved visual search performance on a modified cancellation task in a patient with temporoparietal damage but not in patients with lesions extending anteriorly into frontal cortex. These results suggest that positive motivational modulation may only boost attention if frontal cortex is intact, and is in keeping with research showing that frontostriatal circuits are necessary for reward processing. The findings have significant implications for rehabilitation strategies, and potentially provide insight into the variable response to dopaminergic therapy that has been observed in patients with neglect.

C17

EXOGENOUS TACTILE ATTENTION IN DETECTION AND DISCRIMINATION TASKS: EVENT RELATED POTENTIALS AND BEHAVIOURAL MEASURES Alexander Jones[1], Bettina Forster[1]; [1]City University London — Exogenous orienting is when our attention is automatically driven by external stimuli, such as a flash of light or tap on our shoulder. Behavioural studies of exogenous attention have demonstrated inhibition of return (IOR) in detection of tactile targets and mixed results in discrimination tasks. Event related potential (ERPs) experiment investigating exogenous attention have highlighted possible neural correlates of IOR in vision, however, no previous study has investigated how exogenous tactile attention affects somatosensory processing. In the present study non-informative lateralized tactile cues followed by tactile targets were presented to the middle fingers and thumbs. Responses were made vocally and in experiment 1 participants simply detected targets presented to one of four possible locations while in experiment 2 they discriminated the location (thumb/index) regardless of which hand the target was presented to. Behavioural results showed clear IOR in the detection task whilst no difference between cued or un-cued targets in the discrimination task. ERPs from the detection and discrimination task showed an early (N80) enhanced negativity for uncued compared to cued targets suggesting exogenous attention affects early somatosensory processing, possibly in primary somatosensory cortex. Overall ERP effects were remarkably similar for both tasks, with the only difference relating to laterality of the P100 component where detection task yielded a contralateral P100 attention effect and discrimination task an ipsilateral P100 effect. To our knowledge, this study is the first to explore ERPs within exogenous tactile attention, and shows that exogenous attention modulates somatosensory processing at earlier stages than reported in vision.

C18

MEG CORRELATES OF UNAWARENESS OF LEFT-SIDED STIMULI IN VISUAL NEGLECT Federica Rastelli[1,2], Catherine Tallon-Baudry[1,3,4], Monica Narcisa Toba[1,2], Raffaella Migliaccio[1,2,5], Christophe Duret[7], Pascale Pradat-Diehl[6,8], Paolo Bartolomeo[1,2,5,9]; [1]Université Pierre et Marie Curie-Paris6, Centre de Recherche de l'Institut du Cerveau et de la Moelle epiniere, UMR-S975, Paris, France, [2]Inserm, U975, Paris, France, [3]CNRS (Centre National de la Recherche Scientifique), UMR 7225, [4]CENIR (Centre de Neuroimagerie de Recherche), Hôpital de la Pitie´-Salpêtrière, Paris F-75013, France, [5]Catholic University, Milan, Italy, [6]AP-HP, Groupe Hospitalier Pitié-Salpêtrière, Service de Médecine Physique et Réadaptation and INSERM

U731, Paris, France, [7]Médecine Physique et Réadaptation, Unité de Rééducation Neurologique CRF "Les Trois Soleils" Boissise le Roi, France, [8]Université Pierre et Marie Curie-Paris6, France, [9]AP-HP, Groupe Hospitalier Pitié-Salpêtrière, Paris, France — Patients with right brain damage and visual neglect typically fail to orient and respond to left-sided visual stimuli. Dysfunctional inter-hemispheric interactions, with the left hemisphere taking charge of right-sided objects, but not of left-sided ones, may contribute to neglect signs. However, neglect patients' performance is not always consistent. Identical left-sided stimuli may be either detected or ignored on different trials. Fluctuations in left hemisphere spontaneous activity might account for these variations in performance. We analysed magnetoencephalographic (MEG) activity in the left hemisphere of five right brain-damaged patients with chronic left neglect during a lateralized detection test. The time of presentation of the stimuli was individually titrated, in order to obtain for each patient a substantial number of detections and omissions of left-sided targets. Pre-stimulus MEG activity was separately explored for detected and for ignored left-sided targets. Only for omitted targets, but not for detected ones, there was a left frontal pre-stimuls activity in the low beta band frequencies. We concluded that spontaneous activity in left frontal regions, which are perhaps no longer modulated by attentional regions in the right hemisphere, may interfere with awareness of left targets.

C19

SELECTIVE SUPPRESSION OF ATTENTIONAL COSTS WITH NON-PREDICTIVE ENDOGENOUS CUES: EVIDENCE FROM FMRI AND ERPS INVESTIGATIONS Fabrizio Doricchi[1,2], Stefano Lasaponara[1,2], Massimo Silvetti[1,2], Ana Chica[3], Enrica Macci[1,2], Juan Lupianez[3], Emiliano Macaluso[1]; [1]Fondazione Santa Lucia IRCCS, Rome, Italy, [2]Università degli Studi "La Sapienza", Rome, Italy, [3]University of Granada, Spain — The reaction time advantage for valid as opposed to invalid targets is greater for predictive than non-predictive cues (Doricchi et al., 2009). However, it is still unexplored whether cue-predictiveness has equivalent influence on attentional benefits and costs. In separate fMRI and ERPs investigations, we contrasted the performance of a Posner task with predictive endogenous cues (80% valid/20% invalid trials) with the performance of the same task with non-predictive cues (50% valid/50% invalid trials). Our design comprised also: a) trials with spatially neutral cues, allowing to separate attentional benefits from attentional costs and to study the influence of cue predictiveness on these; b) trials in which the cue was not followed by any target, allowing the study of the influence of predictiveness on endogenous orienting. We found that non-predictive cues caused selective abatement of attentional costs with upholding of attentional benefits. Invalid and neutral targets following non-predictive cues produced equivalent P1 erp whereas invalid targets following predictive cues elicited smaller P1 erp than neutral ones (Luck et al., 1994). During endogenous orienting with predictive cues there was a significant deactivation of the right Temporal-Parietal-Junction (TPJ), whereas no de-activation was present during orienting with non-predictive cues. These findings show that non-predictive endogenous cues selectively abolish attentional costs. This allows speeding up of attentional reorienting and preservation of attentional benefits in contexts characterised by a weak probabilistic relationship between cues and targets. Doricchi F et al. Cereb Cortex. 2009. Luck SJ et al. JEP: HPP. 1994.

C20

PERCEPTUAL LOAD MODIFIES PROCESSING OF DISTRACTOR STIMULI BOTH IN THE PRESENCE AND ABSENCE OF TARGET STIMULI Jane Couperus[1], Erik Hoel[1], Brittany Alperin[1]; [1]Hampshire College — Previous research has shown that perceptual load influences early visual processing by narrowing the focus of visual selective attention (Handy et al., 2001). However, the paradigms utilized have measured changes in electrophysiological activity to unattended probe stimuli presented in the absence of target stimuli (e.g. Barnhardt et al., 2008, Couperus, 2009; Handy et al., 2001). This design does not allow for the effects of perceptual load to be fully appreciated. According to Lavie (1995), increases in perceptual load serve to narrow the focus of attention such that fewer resources are available for processing distractor stimuli. Thus, this effect should be seen both in the presence and absence of target stimuli. Moreover, the level of target processing should not be influenced by the presence of a distractor. To examine this, participants were presented with a bilateral or unilateral display and asked to perform a discrimination task at either low or high perceptual load. Electrophysiological responses to the unattended (ie distractor) stimuli were then compared at the N100. As in previous studies, processing of the distractor stimulus was reduced when the target stimulus was presented at high perceptual load. Moreover, this was true when the target and distractor appeared simultaneously in bilateral displays ($F(1,10)=6.36$, $p=.03$). In contrast, neither target nor distractor processing differed between unilateral and bilateral displays ($F(1,10)=.147$, $p=.94$; $F(1,10)=.402$, $p=.54$) supporting previous studies that suggest effects of perceptual load are influenced by top down processes (e.g. Couperus 2009, Theeuwes et al., 2004) and supporting Lavie's theory more generally.

C21

NEUROANATOMICAL DISSOCIATION BETWEEN N2PC AND SPCN: EVIDENCE FROM MAGNETOENCEPHALOGRAPHY Stephan Grimault[1], Benois Brisson[2], Ulysse Fortier-Gauthier[1], Douglas Cheyne[3], Pierre Jolicoeur[1]; [1]Laboratoire de Neurosciences Cognitives, Cernec, Université de Montréal, Québec, [2]Université Laval, Québec, Canada, [3]Program in Neurosciences and Mental Health, Hospital for Sick Children, University of Toronto, ON, Canada — The N2pc is argued to index visual spatial attention whereas the SPCN (sustained posterior contralateral negativity) has been related to visual short-term memory. The SPCN occurs later and is often separated from the N2pc by an intervening return to baseline or even a contralateral positivity. Some evidence for a dissociation between the N2pc and SPCN has been presented (e.g., Jolicoeur, Brisson, & Robitaille, 2008, Brain Research), but questions remain as to the functional distinctiveness of these two components. We examined this issue by focusing on the neural generators of these components using magnetoencephalography (MEG). A square with a gap in one side (up, down, left, or right) appeared in each visual quadrant (upper left, upper right, lower left, lower right). Each square was in a different (equiluminant) color (red, green, yellow, blue) and target colour was counterbalanced across subjects. The task was to report which side of the target contained the gap. We computed group Event-Related Synthetic Aperture Magnetometry (erSAM) images of the sources related to the activity peaks of the N2pc and SPCN. The erSAM activation maps showed greater parietal activity during the SPCN. These results are consistent with a greater involvement of superior parietal cortex during the retention of representations in visual short-term memory and provides additional neuranatomical evidence for a dissociation of the SPCN from the N2pc, even in speeded tasks that are not explicitly defined as memory tasks.

C22

THE INFLUENCE OF EXOGENOUS CUING ON EYE MOVEMENTS DISSOCIATES LOCATION- AND OBJECT-BASED INHIBITION OF RETURN Conor Mullin[1,2], Jared Allen[1], Heather Jordan[1,2,3], Mazyar Fallah[2,3,4]; [1]York University, [2]Centre for Vision Research, York University, [3]School of Kinesiology and Health Sciences, York University, [4]Canadian Action and Perception Network — Inhibition of Return (IOR) – increased RTs to previously cued, compared to uncued, targets is considered to reflect an inhibitory mechanism which biases processing resources from returning to a recently visited region. IOR manifests itself in both manual (Posner & Cohen, 1984) and saccadic (Maylor, 1985) RTs. The locus of influence of inhibition remains unclear. Posner & Cohen (1984) suggested that the withdrawal of attention initiates an inhibitory "tag", biasing attention from returning. However, there is a close relationship between the oculomotor system and IOR as an oculomotor structure (SC) plays an important role in generating the IOR effect (Sapir et al, 1999) and saccades deviate away from previously cued regions (Theeuwes & Godijn, 2004). Abrams and Dobkin (1994) suggested that IOR influences both attention and eye movements. We note that IOR is associated with both spatial locations, and the objects that occupy them (Tipper et al 1994; Jordan & Tipper, 1998), suggesting that these effects reflect independent mechanisms. Abrams and Dobkin's (1994) observation of attentional and motoric inhibitory influences could be explained by the probing of location and object-based IOR in different experiments. Using a procedure which measures location- and object-based IOR, in the same display, we examined eye-movement RTs and metrics. We confirm that motoric influences of IOR are only observed at the cued location, and identify changes in the flight characteristics of the saccades. We find no effects of object-based IOR on eye movements, indicating that the oculomotor system neither mediates nor is affected by this mechanism.

C23

THE EFFECT OF TMS ON THE INTER-HEMISPHERIC INTERACTION BETWEEN LEFT AND RIGHT IPS: AN FMRI STUDY Lorella Battelli[1,2], Ela Bhatt[2], Zaira Cattaneo[3], Thomas Carlson[4], Alvaro Pascual-Leone[2]; [1]Italian Institute of Technology, Italy, [2]Harvard Medical School, [3]Università degli Studi di Milano, Italy, [4]University of Maryland — Inter-hemispheric balance between homologous areas within the posterior parietal lobe is crucial to perform visual tasks engaging attention in both visual fields simultaneously. We have recently conducted a 1 Hz TMS study (Battelli et al., 2009) where the subjects were asked to perform a visual tracking task immediately after the stimulation. We showed that after the intra parietal sulcus (IPS) was disrupted by TMS subjects were unable to perform the task in the field contralateral to the stimulated side. The deficit was selective for the bilateral tracking condition, thus replicating visual extinction in parietal lesion patients. In the present study each subject underwent two fMRI sessions immediately after 15 min low-frequency offline TMS and Sham over the left IPS. We studied the hemodynamic changes immediately after TMS or Sham in the stimulated and the non-stimulated homologous IPS. We also measured signal intensity changes across all TMS and Sham runs. The results showed significant intracortical hemodynamic changes after TMS over the IPS. In particular the voxel count after TMS was significantly higher in the non-stimulated IPS relative to the stimulated left IPS. We did not find such imbalance after Sham stimulation. This result is in agreement with fMRI studies in neurological patients where they showed that in the acute stage after a unilateral stroke, areas in the healthy hemispheres were hyperactive and such activity was comparable to normals only in the chronic stage (along with improvement in behavioral measures). Our study mimicked a similar result in the normal population using TMS.

C24

VISUO-MOTOR DEFICITS AND DAMAGE TO WHITE MATTER TRACTS IN A POSTERIOR CORTICAL ATROPHY PATIENT Raffaella Migliaccio[1,2,3,7], Monica N. Toba[1,2,3], Federica Agosta[6], Fabian Corlier[1,4], Leonardo Cruz De Souza[1,2,3], Stephane Lehericy[1,2,3,5], Dalila Samri[1,4], Marie Sarazin[1,2,3,4], Bruno Dubois[1,2,3,4], Massimo Filippi[6], Paolo Bartolomeo[1,2,3,4,7]; [1]CR-ICM Centre de Recherche de l'Institut du Cerveau et de la Moëlle Epinière, Paris, France, [2]Universite' Pierre et Marie Curie, Paris, France, [3]INSERM, France, [4]Groupe Hospitalier Pitié-Salpêtrière, Paris, France, [5]CNRS UMR7225, [6]Neuroimaging Research Unit, Scientific Institute and University San Raffaele, Milan Italy, [7]Catholic University, Milan, Italy — OBJECTIVE: To explore anatomical correlates of cognitive and visuo-motor deficits in a patient with Posterior Cortical Atrophy (PCA), by using Diffusion Tensor (DT) MRI-based tractography. BACKGROUND: PCA is a clinical syndrome characterized by progressive complex visual and visuo-motor dysfunctions, associated with grey matter atrophy in posterior brain areas. Few studies have explored the involvement of white matter (WM) in PCA. DESIGN/METHODS: Behavioral and imagery data were acquired in a 58-years-old patient with PCA (woman, right-handed, disease duration 18 months). Tractography was used to assess the integrity of major WM cerebral tracts. Brain structural and 18F-fluoro-deoxy-glucose positron emission tomography (FDG-PET) were also obtained. RESULTS: PCA patient had left visual neglect, optic ataxia, and left limb apraxia. Structural MRI and FDG-PET showed respectively a pattern of focal atrophy and hypometabolism in the parietal lobe bilaterally, with right side predominance. Tractography demonstrated severe WM damage in the right inferior fronto-occipital (IFOF) and superior longitudinal (SLF) fasciculi, while the left IFOF and SLF were relatively spared. Reduction of WM structural integrity was also observed in parietal projections of corpus callosum (CC). No damage was found in the inferior longitudinal fasciculus and corticospinal tract, bilaterally. CONCLUSIONS: This study suggests that damage to IFOF, SLF and posterior CC contribute to the development of cognitive deficits in PCA, consistent with evidences from focal brain lesions that WM tracts are involved in neglect (IFOF and SLF), optic ataxia (SLF), and limb apraxia (CC). Our findings might contribute to the understanding of anatomical correlates of the PCA clinical syndrome.

C25

EFFECT OF PRISM ADAPTATION IN CORTICAL ACTIVITY IN NEGLECT PATIENT Arnaud Saj[1], Roland Vocat[2], Patrik Vuilleumier[3]; [1]Laboratory for Behavioral Neurology and Imaging of Cognition, [2]University Hospital of Geneva, [3]University Medical Center, Faculty of Medicine, University of Geneva — Hemispatial neglect is often resistant to rehabilitation. Recent studies suggested that this disorder may be improved by prism-adaptation, with remarkable generalization and persistence of such effects, but the underlying neural mechanisms remain unclear. functional neuroimaging in healthy volunteers indicates that prism-adaptation relies on a distributed network including posterior parietal, temporal, and cerebellar regions, which is partly damaged in neglect patients. We used fMRI to investigate the effect of (right-deviating) prism-adaptation on seven patients with left neglect while they perform various cognitive tasks on the same visual stimuli (bisection, search, and memory), before and after a brief prism-adaptation session. Behavioural data showed significant improvement ($p<0.03$) following prism-adaptation only for the bisection and search tasks. Preliminary fMRI analysis comparing brain activity after > before adaptation showed selective increases in the right posterior parietal cortex and right middle frontal cortex ($p = 0.001$) during bisection, as well as increases in the right inferior parietal lobule and right occipital cortex during visual search. No significant change was observed for spatial memory. Our results provide new evidence that the beneficial effects of prism adaptation on neglect are linked to a specific modulation of brain regions crucially involved in spatial attention.

C26

ELECTROPHYSIOLOGY OF SELECTIVE ATTENTION TOWARD GRASPABLE SPACE David Leland[1], Catherine Reed[2], Michael Strom[2], John Garza[3]; [1]Pitzer College, [2]Claremont McKenna College, [3]University of Denver — Our hands work in conjunction with our eyes to gather information from the world and to act upon it. Part of this interaction involves a bias of attention toward visual events in the vicinity of the hands, leading to faster reaction times (RT). Visual space near the palm in particular ("graspable space") is associated with a greater RT bias than space just near the back of the hand. We hypothesize a corresponding increase in the amplitude of event-related potential (ERP) components associated with selective attention. During electroencephalographic (EEG) recording, subjects placed one hand near a target location on a monitor and used the other hand to indicate target detection. The target could appear near either the palm or the back of the hand. A purely visual condition, with the hand at rest away from the monitor, served as a control. Preliminary analyses suggest a graded effect of hand condition on the amplitude of a fronto-centrally-distributed late positive ERP component peaking at 250 ms, with palm > back > rest, measured from baseline and peak-to-peak from an earlier negativity (170 ms). These findings are consistent with modulation of a N1-P2 type complex, which reflects the influence of attention on sensory gating, feature detection, and/or working memory, and may reflect enhanced selective attention for stimuli in the vicinity of the hand in general and for graspable space in particular.

C28

MIGRAINE IS ASSOCIATED WITH VISUAL FIELD ASYMMETRIES IN COGNITIVE EXPECTANCIES Marla J. S. Mickleborough[1], Andreea S. Toma[1], Raphaelle N. Roy[1], Todd C. Handy[1]; [1]University of British Columbia — Migraine is a disabling neurological disorder that affects more than 10% of adults worldwide. Heightened visual sensitivity is a hallmark of migraine, both during and between attacks, and appears in the form of photophobia, increased sensitivity to light, increased discomfort from illusions, decreased critical flicker fusion rate, and decreased contrast and global motion processing. Here we used event-related potentials (ERPs) to examine whether these chronic visual sensitivities in migraine translate into a difference in visual attentional expectancies between migraine and non-migraine populations. Participants performed a spatial orienting task as ERPs were recorded. We compared 24 migraineurs to 24 non-headache controls. We found that migraineurs have normal visual sensory and visual discriminative processing as measured by the lateral occipital P1 and N1, respectively. For the post-discriminative P3 component, both groups showed a normal attention effect, but the migraine group also had visual field asymmetry. The P3 component is considered a cognitive processing component, indexing expectation of target stimulus. Our data suggest that, in addition to heightened visual sensitivities, migraineurs have altered visual expectancies specifically within the left visual field.

C29

A COMPUTATIONALLY EXPLICIT NEUROCOGNITIVE THEORY OF OCULOMOTOR INHIBITION OF RETURN (IOR) BASED ON HABITUATION OF EXOGENOUS SIGNALS Jason Satel[1], Zhiguo Wang[2], Raymond Klein[1], Thomas Trappenberg[1]; [1]Dalhousie University, [2]Chinese Academy of Sciences — Inhibition of return (IOR) is an orienting phenomenon characterized by slower behavioral responses to targets that have been spatially cued, relative to uncued locations. Controversy and seemingly contradictory results have led to confusion in the literature regarding the neural generators and stages of cognitive processing involved in IOR. There is, however, general agreement that at least a subset of IOR-like phenomena are mediated at the level of the superior colliculus (SC). Recent neurophysiological investigations have further demonstrated that IOR is accompanied by reduced responses to exogenous inputs in the SC. Here, we develop a neuroscientifically based neural field model of the intermediate layer of the SC which implements an early sensory habituation account of IOR. The primary goal of this work is to examine the extent to which behavioral and neurophysiological results in the literature might be explained in terms of habituation at the level of the SC. A variety of key findings in the literature are generated by this relatively simple model, including the biphasic pattern of facilitation at short stimulus onset asynchronies (SOAs) and IOR at long SOAs, vector averaging of IOR, decreased IOR when fixation is removed before the target is presented (gap effect), and the co-existence of IOR and endogenous orienting at the same location. Experiments demonstrating IOR in cases with little or no SC involvement could potentially be explained and modelled in terms of additional cortical processes, such as habituation of input signals to frontal or parietal areas involved in orienting.

C30

P300 RESPONSES IN VISUO-SPATIAL NEGLECT REFLECT TASK ACCURACY Sven P. Heinrich[1], Michael Bach[1], Árni Kristjánsson[2], Styrmir Sævarsson[1]; [1]Albert-Ludwigs-Universität, Freiburg, [2]Háskóli Íslands, Reykjavík — Impairments of attentional mechanisms are thought to play a key role in neglect. The P300 component of the event-related potential (ERP) has been proposed as a measure for the allocation of attention, making it a promising tool in the investigation of neglect. We recorded ERPs from six participants with chronic unilateral neglect following stroke who performed an oddball task. The stimuli consisted of pairs of symbols presented in the left and right visual field. Infrequent targets could appear either in the affected contralesional or the unaffected ipsilesional visual field. The participants indicated whether a predesignated target was present or not. Contralesional targets produced weaker average P300 responses than ipsilateral targets, but stronger responses than distractor-only stimuli. In the contralesional visual field, missed targets produced a smaller P300 than recognized targets, but slightly larger than correctly identified distractor-only stimuli. The number of missed contralesional targets was positively correlated with the time required for the completion of standard neglect tests. The results, in particular the finding that the P300 reflects task accuracy, support an important role for attentional impairments in neglect. (Supported by the Deutsche Forschungsgemeinschaft and the Deutscher Akademischer Austauschdienst.)

C31

DON'T LOOK HERE: HIGH-DENSITY EEG RECORDINGS IN A PRO- AND ANTI-SACCADIC TASK Daniel Belyusar[1], Adam C. Snyder[1], Hans-Peter Frey[1], Josh Wallman[2], John J. Foxe[1]; [1]Program in Cognitive Neuroscience, City College of the City University of New York, NY, [2]City College, City University of New York, NY — Despite the wealth of research surrounding visual saccades, questions remain about the cognitive processes preceding the actual movement itself. When distractors are presented along with targets, either the reaction time or the saccadic end-point can change (Walker et al., 1997), but prior knowledge decreases behavioral cost of the distraction (Ruff and Driver, 2006). If subjects are instructed to make a saccade to a location at the same distance as the target but in the opposite direction (anti-saccade), reaction times are increased and subjects erroneously make saccades to the target (pro-saccades) (Fischer and Weber, 1991). Several electrophysiological features have been correlated with preparation for attentional deployment and movement. Prior research also suggests that changes in Alpha-band activity (8-14Hz) band power may correlate to preparatory states when one is required to suppress activation in tasks involving attentional shifts (Worden et al., 2000). However, there has not been a thorough characterization of the electrophysiological features invoked in the basic saccade task. The present study looks at the effects of distractors and preparation in saccade tasks. High-density electroencephalography was performed while participants made visual-stimulus-guided pro- or anti-saccades randomly presented to the left and right of fixation. Preliminary results suggest an increase in preparatory Alpha-band activity (~10 Hz) in the anti-saccade task compared to pro-saccade. Increases in Alpha-band activity are seen bilaterally, potentially indicating a preparatory suppression of the pre-potent response. These results suggest that Alpha activity might not only be related to covert attentional deployments, but also to preparation for explicit eye movements.

C32

HORIZONTAL-VERTICAL LENGTH COMPARISON AND THE PERCEPTUAL SYMMETRY LAW IN LEFT VISUAL NEGLECT Pom Charras[1,2], Juan Lupiáñez[1], Paolo Bartolomeo[2]; [1]Universidad de Granada, [2]Inserm U975, CRICM, Paris — Left unilateral neglect usually arises after right parietal damage and is characterized by a left-right imbalance in sensory processing. Typically, neglect patients deviate rightward when bisecting lines. An underestimation of the left portion of the line and/or a right overestimation could explain this effect. We aimed at dissociating their respective contribution to patients' performance, by using a line length comparison task in which participants compared a vertical segment to an horizontal segment either left or right-sided. Moreover, based on recent evidence that normals underestimate lines symmetrically bisected as compared to lines asymmetrically bisected, the present study also aimed at testing whether this symmetry law was preserved in neglect. We tested eight patients suffering from left unilateral neglect and eight control participants. The results showed that controls and patients underestimate symmetric as compared to asymmetric bisections, and confirmed that neglect patients both underestimate left-sided stimuli and overestimate right-sided stimuli. Our results suggest that left unilateral neglect might reflect a deficit in attentional orienting to the left coupled with a disengagement deficit from right-sided stimuli, and that the symmetry law is driven by pre-attentive mechanisms.

C33

TIME-SERIES ANALYSIS OF EYE MOVEMENTS REVEALS INHIBITION OF RETURN IN NATURAL SCENES Paul Bays[1], Masud Husain[1]; [1]University College London — Active exploration of the visual world depends on sequential shifts of gaze that bring prioritized regions of a scene into central vision. The efficiency of this system is commonly attributed to a mechanism that inhibits return to previously examined locations. However, analysis of gaze patterns in naturalistic visual scenes appears to contradict this hypothesis, instead revealing a surprisingly strong tendency to shift gaze back to the location of the previous fixation – suggesting that such refixations might even be facilitated under natural conditions. Here we present a novel time-series analysis of eye movements during free-viewing and search of naturalistic scenes. We decompose the instantaneous influences on saccade selection into two components: the attentional priority observers assign to different regions of a scene, and their systematic bias towards certain amplitudes and directions of eye movement. We demonstrate that the observed frequency of refixations is in fact substantially less than predicted for a memoryless system of saccade selection, indicating that return fixations are actively inhibited in natural viewing.

C34

IPSILESIONAL ATTENTIONAL DEFICITS IN RIGHT HEMIANOPIA Celine Perez[1,2,3], Celine Cavezian[1,2,3], Isabelle Gaudry[1,2,3], Mickael Obadia[3], Olivier Gout[3], Monte Buchsbaum[4], Sylvie Chokron[1,2,3]; [1]Laboratoire de Psychologie et NeuroCognition, CNRS, UMR5105, UPMF, Grenoble, France, [2]ERT Treat Vision, Fondation Ophtalmologique Rothschild, Paris, France, [3]Service de Neurologie, Fondation Ophtalmologique Rothschild, Paris, France, [4]Radiology and Neuroscience, Mount Sinai School of Medicine, Mount Sinai Medical Center, New York City — Most studies on homonymous hemianopia (HH) concentrate on the blind visual field and rarely investigate possible deficits within the healthy, ipsilesional visual field. The present study tested the hypothesis of an ipsilesional attentional deficit in patients with right HH (RHH) following a left occipital lesion. Fifteen healthy, dextral males (59.8 ± 33.5 years) and 4 male RHH patients (53.5 ± 18.7 years) completed a letter-detection task in the left visual field (LVF). The target could appear as a small letter surrounded by flankers (Surrounded) or alone as a large letter (Alone). This task was previously used to demonstrate a left hemisphere superiority for local selective attention but a right hemisphere superiority for global selective attention (Chokron, Brickman, Wei and Buchsbaum, Cogn Brain Res, 9, 85-90; 2000). Overall, no difference in reaction time was seen between patients and controls in the LVF. Regarding accuracy, controls did not exhibit a significant effect of the stimulus, but patients were significantly less accurate to Surrounded targets (54% ± 40.9 of correct responses) compared to Alone targets (98% ± 2.7 of correct responses). Despite comparable processing time for stimuli in the ipsilesional LVF, the processing quality is not equivalent in the two groups. RHH patients presented poorer accuracy for selective attention in their 'healthy' LVF. These results support the assumption that attention in unilateral occipital brain damaged patients' ipsilesional field is not "intact" as previously thought, and confirm the specific role of the left hemisphere in local attention even in the ipsilateral visual field.

C35

EFFECTS OF CHRONIC LOW-LEVEL LEAD EXPOSURE ON ALLOCATION OF SPATIAL ATTENTION IN 11-YEAR-OLD INUIT CHILDREN FROM ARCTIC QUEBEC Audrey-Anne Ethier[1,2], Joseph Jacobson[3], Sandra Jacoson[3], Gina Muckle[5], Célyne Bastien[5], Eric Dewailly[4], Pierre Ayotte[4], Pierrich Plusquellec[4], Dave Saint-Amour[1,6]; [1]Centre de recherche, CHU Sainte-Justine, [2]Université de Montréal, [3]Behavioral Neurosciences, Wayne State University, [4]Unité de Recherche en Santé Publique, CHUL, [5]École de psychologie, Université Laval, [6]Université du Québec à Montréal — Environmental exposure to lead is a risk factor for attention deficits (e.g., Braun et al., 2006), even at very low levels (e.g., Chiodo et al., 2004). We have reported that chronic lead exposure may affect sustained attention at relatively low doses in 5-year-old Inuit children from Arctic Quebec (Plusquellec et al., 2009). The aim of this study was to assess the impact of lead exposure on allocation of spatial attention using a Posner cue-target paradigm in this same population at school-age (M = 10.8 yr). Blood lead concentrations were measured in 23 Inuit children at birth and 11 years, indicating pre- and postnatal exposure (M=5.8, SD=3.9 and M=2.9, SD=1.7), respectively. Children were instructed to detect a pre-cued target (horizontal grating) as quickly as possible that appeared on the left or the right of a fixation point. A valid trial consisted to present the target at the cued location, by contrast to an invalid trial. The "Posner effect" was obtained by subtracting reaction time (RT) of valid trials (M=589, SD=107) from RT of invalid trials (M= 655, SD=115). Results showed a negative correlation between postnatal lead concentration and the Posner effect ($r = -0.51$, $p = 0.03$), which remained significant (? = -0.58, $p = 0.01$) after adjustment for methylmercury and PCBs, two other environmental contaminants to which these children are exposed. These data indicate that chronic low level lead exposure alters the ability to allocate spatial attention at school age.

C36

TO SEARCH OR NOT TO SEARCH: TRACKING THE DEPLOYMENT OF ATTENTION IN RELEVANT AND IRRELEVANT VISUAL DISPLAYS John McDonald[1], Victoria Harms[1], Jessica Green[1], Ali Jannati[1], Vincent Di Lollo[1]; [1]Simon Fraser Univeristy — Visual search is believed to involve a dynamic interplay between bottom-up and top-down factors (salience and intention, respectively), but there is no consensus about the stages at which these different factors control the covert deployment of attention. Some researchers have proposed that stimulus salience controls the initial stages of visual search; others have proposed that an observer's intentions can override salience at the earliest stages of visual processing. Evidence for salience-driven attention capture has come from studies in which observers actively searched for a target in the presence of a salient distractor. Here, we asked whether stimulus salience also controls attentional deployment when observers are not required to search for a target. Participants viewed displays of blue lines and of yellow lines on randomly intermixed trials. In Experiment 1, they responded to orientation singletons regardless of colour (all relevant displays); In Experiment 2, they responded to orientation singletons when displays were of one colour (relevant displays) but not the other colour (irrelevant displays). Orientation singletons elicited the N2pc – an electrophysiological measure of attentional deployment – only when the display was relevant; the very same stimuli failed to capture attention when participants were in a don't-search mode. Moreover, the decision to search in Experiment 2 delayed the N2pc relative to the N2pc in Experiment 1 (when observers were always in search mode). This shows that an observer's attentional set can override salience-driven deployments of attention even at the earliest stages of search.

C37

SIMILAR PERCEPTUAL COSTS FOR DIVIDING ATTENTION BETWEEN RETINA- AND SPACE-CENTERED TARGETS IN HUMANS Robert Niebergall[1,2], Lawrence Huang[1], Julio C. Martinez-Trujillo[1]; [1]McGill University, [2]German Primate Center — One subject that has been a matter of debate in studies of vision is whether attention is preferentially allocated to stimuli fixed in a retina-centered reference frame, or whether it could be equally allocated to stimuli fixed in other reference frames. We investigated this issue by asking human observers to discriminate small changes in the orientation of one of two sinusoidal gratings while pursuing a moving dot under different experimental conditions. During the experiments, one grating remained fixed in a retina-centered frame while the other remained fixed in a space-centered frame. In focused attention trials subjects attended to one grating while ignoring the other. In divided attention trials they simultaneously attended to both gratings. We found that when focusing attention on one grating, orientation-change discrimination thresholds (ODTs) were lower for the retina-centered relative to the space-centered grating. This effect was attributed to increases in ODT with increases in the stimulus retinal velocity. However, when subjects divided attention between both gratings, the ODT corresponding to either stimulus decreased by a similar amount. These results demonstrate that humans can simultaneously allocate attention to equally relevant targets fixed in different reference frames without a significant bias toward a particular frame.

C38

ALTERATION IN THE SPATIAL ORIENTATION OF VISUAL ATTENTION IN AMBLYOPIA Judith Hotte-Bernard[1,2,3], Mariline Pageau[1], Franco Lepore[1,2,3], Dave Saint-Amour[1,4]; [1]Centre de recherche CHU Sainte-Justine, [2]Université de Montréal, [3]Centre de Recherche en Neuropsychologie et Cognition, [4]Université du Québec à Montréal — Amblyopia is classically defined as reduced visual acuity in one eye not attributable to structural ocular anomalies, suggesting a cortical origin. It has been recently suggested that visual attention may be affected in amblyopia. Using a Posner paradigm we tested the hypothesis that orienting spatial attention is altered in amblyopia. Methods : Twelve adults with normal vision and eight amblyopic adults participated in this study. Under monocular viewing, participants were asked to detect a visual target as quickly as possible following a valid, neutral or invalid auditory cue to its location. The Posner effect was obtained by subtracting reaction time (RT) for valid trials from RT for invalid trials. Results : The Posner effect is significantly observed in the amblyopic eye (mean RT difference = 78 ms, p = .028) and control eye (mean RT difference = 77 ms, p = .001). Interestingly, it isn't significantly present in the fellow eye of amblyopic participants. Conclusion : Our findings suggest a more noticeable alteration in the spatial orientation of visual attention in the fellow eye of amblyopic subjects. A larger dataset will allow us to distinguish amblyopic participants based on the severity of their visual deficit.

C39

GAZE-TRIGGERED ORIENTING WITH CONTRAST-INVERTED FACES Chris Kelland Friesen[1], Heather Kay Wadeson[1], Annie T. Ciernia[2], Reiko Graham[3]; [1]North Dakota State University, [2]University of California, Irvine, [3]Texas State University, San Marcos — Although people are very accurate at judging the gaze direction of others, studies have found that gaze direction perception is impaired (Ricciardelli, Baylis, & Driver, 2000; Olk, Symons, & Kingstone, 2008) or even reversed (Sinha, 2000) when observers make judgments about the gaze direction of a contrast-inverted face. It has therefore been proposed that gaze perception might be accomplished by means of a heuristic whereby gaze direction is simply derived from the position of the dark (pupil and iris) within the white (sclera) region of the eye. Here, we used a standard gaze-cuing paradigm to examine the effect of contrast inversion on attentional orienting to gazed-at peripheral targets. We presented photographic negative images of a face that looked straight ahead and then gazed nonpredictively to the left or right. With a cue-onset to target-onset interval of 300 milliseconds, participants were faster to detect a target appearing at a gazed-at location compared with at a location opposite to where gaze was directed. With intervals of 100 and 600 ms, the cuing effect was not significant. Importantly, in contrast to the findings of Tipples (2005) with static computer-generated faces, in no case was the cuing effect reversed. Our results indicate that the "look for the black" heuristic is not the only means by which gaze perception is efficiently accomplished, and that the geometry of the eye is used in the perception of gaze and the subsequent rapid deployment of spatial attention to where the eyes are looking.

Emotion & Social: Emotion-Cognition Interactions

C40

INDIVIDUAL DIFFERENCES IN EMPATHY MODERATE REFLEXIVE ORIENTING TO GAZE DIRECTION WITH EXPRESSIVE FACES Reiko Graham[1], Janine Harlow[1], Chris Kelland Friesen[2]; [1]Texas State University, [2]North Dakota State University — Personality differences, anxiety in particular, have been postulated to moderate reflexive orienting to gaze in fearful faces. This study examined whether individual personality differences (anxiety, self-esteem, empathy) influence the magnitude of the gaze-cuing effect to happy and fearful faces. Sixty-eight participants (22 males, 46 females, M age = 20.5 years) completed self-report questionnaires and a reflexive gaze-cuing task that used happy and fearful laterally gazing faces as cues and valenced objects (smiling baby, snarling dog) as targets appearing at short and long stimulus-onset asynchronies (SOAs). Analyses revealed an overall cuing effect (participants were faster to identify validly-cued targets), mitigated by a SOA x emotion x validity interaction. At short SOAs, the cuing effect was only significant for fearful faces, while it was present for both fearful and happy faces at long SOAs. Follow-up regressions indicated that cuing effects at short SOAs were not related to personality differences. In contrast, cuing effects at long SOAs were predicted by individual differences in empathy. High scores on the Fantasy subscale (Davis, 1980) were predictive of enhanced cuing, while high scores on the Empathic Concern subscale were predictive of attenuated cuing. Surprisingly, anxiety did not modulate cuing effects to fearful faces. Together, these results suggest that reflexive orienting to expressive gazing faces is sensitive to the amount of time that intervenes between the gaze cue and the target. Furthermore, individual differences in empathy appear to moderate this effect, but only when there is sufficient time to process the face cue.

C41

THE DYNAMIC EFFECT OF EMOTION ON TIME PERCEPTION: DIFFERENTIATING BETWEEN ATTENTIONAL AND ACTIVATIONAL INFLUENCES Julie Anne Seguin[1], Gina, M. Grimshaw[1], David, N. Harper[1]; [1]Victoria University of Wellington — A stimulus' emotional content can affect its perceived duration. In recent studies, the powerful task known as temporal bisection has revealed that emotion effects are in line with activational theories of time perception. However, temporal bisection has only been used for short durations (below 2 seconds). In the present study, temporal bisection was used to determine whether activational effects of emotion also prevail at longer durations. Participants were assigned to a duration range (400-1600ms or 2000-6000ms) as well as to one of four emotion categories created by combining arousal (high or low) and valence (positive or negative). Participants were shown emotional and neutral images of varying durations and asked to decide whether these durations were closest to the short or long anchor. Point of subjective equality analyses revealed that in the short duration range, results were in accordance with previously reported activational theories (high arousal images were estimated to last longer than low arousal images). In the longer range, however, the duration of high arousal images as well as low arousal negative images was underestimated in comparison to low arousal positive images. These findings are in marked contrast with the activational account and instead, are in line with attentional theories of time perception. Taken together, these contrasting results suggest a dynamic effect of emotion on time perception. In short durations, time estimates are guided by the amount of stimulus-induced activation and arousing stimuli are overestimated. In longer durations, activation subsides and attention-grabbing stimuli are underestimated.

C42

COGNITIVE AND METABOLIC SUBSTRATES OF EMOTIONAL VULNERABILITY IN TEMPORAL LOBE EPILEPSY PATIENTS Laura Lanteaume[1,2], Eric Guedj[3,4,5], Mireille Bastien-Toniazzo[1,2], Olivier Mundler[3,4,5], Patrick Chauvel[6,7,8], Fabrice Bartolomei[6,7,8]; [1]Laboratoire Parole et Langage CNRS, [2]Université de Provence UMR 6054, Aix-en-Provence, France, [3]CHU Timone, Service Central de Biophysique et Médecine Nucléaire, [4]CERIMED, Université de la Méditerranée, [5]CHU Conception, Centre d'Investigation Clinique, INSERM, Marseille, [6]CHU Timone, Service de Neurophysiologie Clinique, [7]INSERM, U751, [8]Université de la Méditerranée, Marseille — Background: There is some evidence that emotional precipitants can induce seizures in susceptible people with epilepsy. Nonetheless, the existence of emotional vulnerability is mainly based on self-perception and little is known concerning potential cognitive and brain dysfunctions associated to the phenomena. We sought to identify a possible link between the self-perception of affective precipitants, the cognitive responses modulated by aversive information (attentional bias), and the brain metabolic modifications, in patients suffering from Temporal Lobe Epilepsy (TLE) and reporting to have an emotional vulnerability (seizure precipitated by stressful events). Methods: The extent to which seizures were elicited or not by emotional precipitants was estimated using a self-reported scale, allowing distinction of two groups: "Emo-TLE" group and "Other-TLE" group. Attentional biases were assessing with the Dot Detection paradigm, using negative and neutral stimuli. Interictal brain metabolism was studied using FDG-PET. Cognitive and imaging comparisons were made between healthy individuals, Control group, and either Emo or Other TLE groups. Results: Approximatively 50% of patients have reported an effect of emotional precipitants on seizure release. These Emo-TLE participants disclosed specific attentional biases toward negative stimuli compared to neutral ones, and to Other-TLE and Control groups. Emo-TLE also exhibited significant anterior temporal lobe hypometabolism. Conclusion: This investigation therefore suggests that Emotional Vulnerability in some patients is not only the results of self-perception but that it might be underlined by specific cognitive and brain metabolic modifications, in response to stressful events.

C43

CAN ATTENTION MODULATE EMOTION? Noga Cohen[1], Avishai Henik[1], Nilly Mor[2]; [1]Ben-Gurion University of the Negev, Beer-Sheva, Israel, [2]Hebrew University of Jerusalem, Jerusalem, Israel — Interactions between emotion and attention are shaped by evolution in order to produce adaptive behavior. However, these interactions may take a different form depending on the attentional network in question and on the processing level of the emotional stimulus. In the current research we used a modified version of the Attention Network Test (ANT) to examine the effect of emotion on each of three attentional networks: alerting, orienting and executive functions. In two experiments, we found that presentation of emotional stimuli altered task performance only in the absence of cognitive conflict. When the task required conflict resolution, emotional stimuli had no influence on performance. Moreover, this interaction was modulated by exposure duration of the emotional stimuli. These results strengthen prior findings from neuro-imaging studies regarding regulation of the effects of emotion during cognitive conflict; namely, when executive processes are needed, inhibitory mechanisms are activated to decrease the disruptive effect of emotions. The ability to inhibit emotions when we need to quickly solve a cognitive conflict is crucial for survival.

C44

SELECTIVE ATTENTION AND CONFLICT PROCESSING UNDER PRIMARY INCENTIVES: EVIDENCE FROM THE FLANKER TASK Kimberly S. Chiew[1], Todd S. Braver[1]; [1]Washington University in St. Louis — Research indicates that motivational incentives can enhance cognitive control during task-switching and working memory paradigms. Conflict resolution is another commonly postulated control process, but may be engaged differentially from other control processes (i.e., reactively rather than proactively). We examined positive (reward) and negative (penalty) motivational state effects on conflict processing in the Eriksen flanker task. Reward and penalty blocks involved intermixed incentive and no-incentive trials, with incentive value cued prior to trial onset. Primary incentives (pleasant/unpleasant liquids) were used. Flanker trials were incompatible (conflict), compatible, or neutral, permitting examination of interference and facilitation effects. We observed the classic flanker effect: performance (latency and accuracy) improved from incompatible to neutral to compatible trials. Incentives improved both speed and accuracy of performance, but effects did not differ with incentive valence, suggesting that both reward and punishment can enhance attentional performance. Additionally, latency decreased in incentive blocks relative to baseline, even in trials without incentives offered. This mirrors the 'incentive context effect' (Savine et al., in press), suggesting a sustained, global impact of incentive on performance. However, incentives did not reduce conflict-related interference, suggesting a limited reactive effect. A second experiment examined whether proactive forms of conflict resolution might be differentially sensitive to incentives. Proactive control was engaged by preparatory cues foreshadowing conflict (indicating trial-type). Analyses examined whether incentive information interacted with the presence/absence of trial-type foreknowledge, directly testing whether the 'incentive cue effect' is due specifically to enhanced use of such preparatory cues via motivation-based optimization of proactive, rather than reactive, control.

C45

ELECTROPHYSIOLOGICAL CORRELATES OF VIGILANCE AND DISENGAGEMENT DIFFICULTIES TOWARDS FACES IN SOCIAL ANXIETY Mandy Rossignol[1], Philippot Pierre[1], Campanella Salvatore[2]; [1]Université Catholique de Louvain, [2]Université Libre de Bruxelles — Behavioral studies have extensively used spatial cueing paradigms to investigate emotional biases in clinical and sub-clinical anxiety. However, neural processes underlying the generation of these biases remain uncertain. This study explored the role of attentional disengagement in emotional processing through electrophysiological activity. High and low socially anxious individuals performed a spatial cueing paradigm: a single lateralized cue consisting of an emotional or a neutral face was presented on the left or the right hemi-field. Then, an arrow appeared at the site previously occupied by the face or at the empty location, and the subject had to discriminate the orientation of the target as quickly and accurately as possible. Results showed on occipital locations that perceptual encoding of faces, indexed by P100, and mobilization of attentional resources, reflected in P200, were modulated by social anxiety. Moreover, socially anxious participants displayed enhanced P100 component in response to valid and invalid targets. Furthermore, behavioral results showed that high socially anxious participants were not faster to detect targets appearing in the attended location, while this expected validity effect was observable in low anxious individuals. These results suggest that social anxiety is associated with (1) an hypersensitivity to incoming visual stimuli; and (2) an attentional anchorage leading to disrupted processing of subsequent targets. This support the thesis of an arbitrary selection of relevant information coupled with a lack of control over their processing.

C46

EFFECTS OF ANGRY FACE ON ATTENTION REVEALED BY N2PC COMPONENT Shwu-Lih Huang[1], Yu-Ju Chen[1], Yu-Chieh Chang[1]; [1]National Changchi University — The N2pc component was measured as an electrophysiological indicator of attention orienting to investigate how a task-irrelevant angry face influences attention. Participants had to detect a target dot presented in one of the six schematic faces arranged circularly and discriminate whether the dot located in the left or right side of that face. Six faces were all neutral faces or included an angry face among them. Emotional content of the faces were irrelevant to the task, therefore could be ignored. Five conditions were manipulated inclusive of (1) all-neutral condition: six neutral faces were presented; and (2) angry-target condition: target was presented in the only angry face. In the remaining conditions, target was not presented in the angry face but in a neutral face. That included (3) target and angry face were presented in the same visual hemifields (same-side condition), or (4) in the laterally opposite sides (opposite-side condition), and (5) target was presented on the vertical meridian while angry face was presented laterally (vertical-target condition). Through a time-course analysis, firstly the result showed that attention oriented to the target very early (220-240ms) in all-neutral condition. Secondly, the onset of N2pc component was earlier in angry-target condition (240-260ms) than in same-side condition (260-280ms). And N2pc component was more delayed in opposite-side condition (280-300ms). Finally, in vertical-target condition, attention could hardly be guided to the angry face. In conclusion, effects of task-irrelevant angry face on attention were revealed in the temporal aspect of N2pc component.

C47

LASTING EFFECTS OF EXPOSURE THERAPY FOR SPIDER PHOBIA: ALTERED BRAIN ACTIVATION ASSOCIATED WITH REDUCED FEAR Katherina K. Y. Hauner[1], Susan Mineka[1], Ken A. Paller[1]; [1]Northwestern University — Specific phobia, characterized by excessive fear of an object or situation, is the third most prevalent mental disorder. Exposure therapy for specific phobia can lead to reduced fear following a single, 2-hour session. Neural mechanisms associated with this remarkable therapeutic outcome are not understood. Furthermore, no study has examined whether patients' neural responses to feared stimuli are altered by this form of treatment, nor has any study examined the neural correlates of this treatment's long-term effects. The study's goals were to: (a) identify functional neuroanatomical substrates of fear extinction immediately following exposure therapy, and (b) compare initial results with those 6 months post-treatment. Participants (n=12) met diagnostic criteria for spider phobia at baseline. Neural correlates of phobic fear were obtained before therapy via fMRI contrasts to phobic images (spiders) versus neutral images (moths). Participants then successfully completed the 2-hour treatment, followed by fMRI scanning with novel phobic/neutral images. At 6-month follow-up, participants completed the fMRI paradigm with novel images. Pre-therapy results showed increased activity for phobic versus neutral images in the amygdala, insula, and cingulate gyrus. Results for this contrast immediately post-therapy showed decreased differential activity in these areas, which was maintained at follow-up. Differential activity in the superior frontal gyrus (potentially indicative of cognitive control) increased following therapy for phobic versus neutral stimuli, then decreased at follow-up. These findings are relevant for hypotheses regarding neurocognitive mechanisms of fear extinction, which may involve response inhibition (via superior frontal gyrus) that is operative initially but not required for persistent fear reduction.

C48

DISSOCIABLE EFFECTS OF RELAXATION AND MEDITATION TRAINING ON THE EMOTIONAL REGULATION OF ATTENTION Norman Farb[1], Zindel Segal[1,2], Adam Anderson[1]; [1]University of Toronto, [2]Centre for Addiction and Mental Health, University of Toronto — Our reactions to stressful events have consequences for long-term well-being. Mindfulness training (MT) is associated with reduced risk of depression relapse, perhaps by altering stress reactions. Farb et al. (2009) demonstrated reduced neural reactivity to mood challenge following MT relative to waitlisted controls, particularly in the right insula and posterior cingulate/precuneus. The present study employed an active control group for MT in a true pre/post design: relaxation training is isomorphic to MT in structure and practice requirements, but without an emphasis on cultivating attentional control. In addition to assessing the consequences of mood challenge through valenced film clips, we measured mood effects on attention using a selective attention task employing indoor/outdoor judgments of scenes with superimposed valenced face distracters. Consistent markers of self-reported and neural reactivity to sad films were found across mindfulness and relaxation groups, recruiting cortical midline systems but reducing posterior insula and somatosensory activity. Neural indices of reactivity were reduced following training, although most effects were nonspecific to training type. Consistent with attentional narrowing during negative mood, sadness improved performance on the indoor/outdoor judgment task. By contrast, sad faces increased distraction relative to neutral faces. However, a specific training difference was observed, with MT participants less distracted by sad faces during neutral moods than relaxation participants. Evidence from extrastriate regions sensitive to faces and places was consistent with reduced attention to faces following MT, but not relaxation training. These findings demonstrate that mindfulness training effects extend beyond relaxation, improving executive control over emotional interactions via selective attention.

C49

P300 GREATER SENSITIVITY FOR EMOTIONAL FACE-VOICE ASSOCIATIONS REVEALED BY A CROSS-MODAL ODDBALL PARADIGM Salvatore Campanella[1], Frédéric Joassin[2], Mandy Rossignol[2], Paul Verbanck[1]; [1]Laboratory of Psychological Medicine, University of Brussels, Belgium, [2]Cognitive Neuroscience Unit, University of Louvain, Belgium — Objective – Studies exploring the neurophysiological correlates of main psychiatric disorders commonly used event-related potentials (ERP) during a visual or an auditory oddball task. Main results are focused on P3b amplitude and/or latency modulations. The present study aims at increasing the clinical sensitivity of these P3b modulations by using a more ecological oddball design, defined with synchronized pairs of audio-visual emotional stimuli. Methods – Healthy participants and subjects with depressive and anxious tendencies were successively confronted with a visual, an auditory and an audio-visual (cross-modal) oddball task, in which they had to detect as quickly as possible deviant happy and sad stimuli among neutral ones. Behavioral performance and P3b ERP data (recorded from 32 electrodes) were analyzed. Results – Subjects displaying anxious and depressive tendencies showed a decrement of the P3b amplitude as compared to controls, but only in the cross-modal oddball task. Conclusions - We showed that even if the two groups of subjects differed on their subclinical level of comorbid anxiety and depression, unimodal visual and auditory oddball tasks did not allow us to index this difference by P3b amplitude modulations, whereas the cross-modal task did it. Significance - These results call for using cross-modal oddball designs at a fundamental and clinical level in future studies, in order to increase the sensitivity of P300 amplitude difference shown between healthy and clinical participants.

C50

MODULATION OF ELECTROPHYSIOLOGICAL RESPONSE TO UNPLEASANT PICTURES BY FALSE EXPECTATION Kenta Kimura[12], Toshikazu Hasegawa[1]; [1]The University of Tokyo, [2]Japan Society for the Promotion of Science — Previous studies have demonstrated that emotion regulation such as reappraisal reduced subjective negative feeling and concomitant electrophysiological response such as late positive potential (LPP). Although reappraisal is one of the most well-researched regulation strategies, it is also known that modulation of expectations about how following unpleasant stimuli might feel can alter perceptions of the stimuli in the context of pain. Although several studies showed that false expectation about upcoming pain modulates subjective and neural responses to it, no study has examined it in visual system. Thus, present study examined whether false expectation modulates subjective and electrophysiological responses to unpleasant pictures. Participants were asked to view and rate neutral and unpleasant pictures following one of three cues; unpleasant, misleading, and neutral cues. Unpleasant and misleading cues were followed by unpleasant pictures while neutral pictures were presented after neutral cue. As a manipulation of expectancy, participants were instructed that the unpleasant cue predicted presentation of highly unpleasant pictures while misleading cue did mildly unpleasant pictures. Actually, however, unpleasant pictures following these two cues were controlled as they had same valence and arousal scores. Subjective unpleasant score and amplitudes of LPP during picture presentation were assessed. As a result, participants rated pictures following unpleasant cue more unpleasant compared to pictures following misleading cue. In addition, we found smaller amplitude of LPP during unpleasant pictures following misleading cue than unpleasant cue. These results suggest that not only pain perceptions, expectancy manipulation can modulate perception of unpleasant visual stimuli.

C51

DOES THE SEMANTIC RELATEDNESS OF CONDITIONAL CUES FACILITATE THE TRANSFER OF LEARNED FEAR? Joseph E. Dunsmoor[1], Allison Bullock[1], Kevin S. LaBar[1]; [1]Duke University — In a typical fear conditioning experiment, fear is acquired to a conditioned stimulus (CS) when it is paired with an aversive unconditioned stimulus (US). However, fear can also be acquired to cues that have never been paired with the US, but share a previous association with the CS (sensory preconditioning). While sensory preconditioning has served as an interesting explanation for the development of anxiety disorders, human research on this topic has received sparse attention. The present investigation developed a novel sensory preconditioning paradigm with semantically related or unrelated cues to determine whether higher-order human fear learning is influenced by the semantic similarity of conditional cues. In a between-subjects design, groups received paired fear-relevant cues that were either semantically related (e.g., an image of a spider and an image of a web), semantically incongruent, or unrelated. Similarly matched control stimuli were presented for each group that were never reinforced. One of the cues from each pair was then fear conditioned in association with an electric shock US. Subsequently, the non-conditioned cue in each pair was presented alone to test for the transfer of learned fear. Results showed that all groups exhibited a transfer of conditioned fear (as assessed by the skin conductance response) to the non-conditioned cue that had undergone sensory preconditioning but not to the control stimuli. However, the magnitude of fear was greater, and reaction times faster, in the semantically congruent condition, suggesting an influence of semantic relatedness on higher-order fear learning in humans.

C52

EMOTIONAL CONTRAST AND SELF-REPORTED ANXIETY PREDICT TARGET ACCURACY IN AN EMOTIONAL ATTENTIONAL BLINK PARADIGM Nicholas Van Dam[1], Mitch Earleywine[1], Jeanette Altarriba[1]; [1]University at Albany, SUNY — Manipulating emotional features of stimuli in rapid serial visual processing presents a unique approach to investigate explicit and implicit aspects of emotional perception. Psychopathology may be an important moderating variable in emotion perception. We investigated the effects of type of emotional stimuli and individual differences in psychopathology on emotion identification accuracy in an emotional attentional blink paradigm. Participants completed self-report measures of anxiety, depression, and negative affect. They were then presented with one of three first target (T1) stimuli (neutral, happy, or fearful face), followed at lag 3 (three intervening distracters) or lag 6 (six intervening distracters) by one of three second target (T2) stimuli (neutral, happy, or fearful face). The outcome measure was accuracy of emotion identification for T2 stimuli. Emotion identification was strongly facilitated by a contrast effect, where the two targets were of the opposite emotion (e.g., fearful vs. happy). Anxiety emerged as the only significant predictor of T2 emotion identification accuracy when one of the targets was fearful. However, when there was no fearful stimulus, negative affect was the only predictor of T2 accuracy. These findings provide evidence that emotional contrast influences identification accuracy of rapid emotional visual processing. Additionally, they suggest that anxiety plays a significant role in rapid processing of threat-related stimuli, whereas negative affect plays a role in rapid processing of emotional stimuli more generally. These data have important implications for visual processing of emotional stimuli and for attentional control in emotional disorders.

C53

DISSOCIABLE EFFECTS OF NEGATIVE EMOTIONAL DISTRACTERS DURING HIGH AND LOW COGNITIVE INTERFERENCE CONDITIONS Agnes J. Jasinska[1], Kate D. Fitzgerald[1], Stephan F. Taylor[1]; [1]University of Michigan, Ann Arbor, MI — Daily experience suggests that negative emotional distracters impair cognitive task performance. However, research reports have been inconsistent. The current study was informed by two theoretical accounts. The perceptual load theory (Lavie 2005) proposes that the impact of distracters depends on the level and type of processing load involved in the task: high perceptual load decreases distracter effects, whereas high cognitive load increases distracter effects. A contrasting view (e.g., Eltiti et al. 2005) holds that the impact of distracters on task performance depends on distracter salience. The goal of the present study was to test two hypotheses. First, that negative emotional distracters will impair task performance in high interference condition to a greater degree than in low interference condition. And second, that the impact of distracters will increase with increasing negative emotional salience of the distracters. We employed the Multiple-Source Interference Task (MSIT) (Bush et al. 2003) with high and low interference conditions (stimulus-response incompatibility). We modified the task by adding 3 categories of task-irrelevant flanker distracters: Angry, Fearful, and Neutral faces. 70 healthy females (mean age 22.9±4.06) performed the task. We observed a robust interaction between interference condition and distracter type both in reactions times and in accuracy. As hypothesized, the interference effect increased with increased emotional salience of distracter types: Angry > Neutral > Null. Negative emotional distracters impaired task performance when interference was high, but unexpectedly, they enhanced task performance when interference was low. These results add to our understanding of the processes underlying negative emotional distraction.

C54

FUNCTIONAL ACTIVATION OF PERCEPTION AND ACTION AREAS PREDICT EMOTIONAL RESPONSES TO MUSIC Psyche Loui[1], Charles Li[1], Juan Pablo Bello[2], Robert Rowe[2], Gottfried Schlaug[1]; [1]Beth Israel Deaconess Medical Center and Harvard Medical School, [2]New York University — The human emotional response to music is complex and individually dependent, but maps onto traditional features of sound, such as pitch, rhythm, and loudness. A stable classification system from musical information-retrieval literature has provided us with testable predictions of human arousal ratings based on combinations of sound features. To explore the neural response to emotional arousal in music as manipulated by these sound features, we conducted a parametric, event-related fMRI study using the sparse temporal sampling technique. Short musical excerpts (12s each) were presented to 19 subjects in the scanner. These excerpts were predicted by the classification system to range from lowest to highest in arousal. Subjects' task was to rate the perceived arousal level of each excerpt. In a control task, lateralized white noise was presented and subjects rated the laterality of the noise - a feature of sound that we assume to be unrelated to emotional content. Arousal ratings correlated highly with the classifier but showed considerable between-subject variability. A BOLD signal comparison between all music and noise trials showed widespread bilateral activity in superior temporal structures (STG, STS, MTG) responsible for perception and categorization. Furthermore, a contrast between high-arousal and low-arousal music showed enhanced activity in memory and action-sequencing areas (IFG, DLPFC, and OFC) activity in high-arousal trials. Results suggest that combinations of perceptual features can elicit emotions by recruiting brain regions responsible for perception and categorization, which must then interface with working memory and action sequencing functions to derive the emotional experience.

Emotion & Social: Development & Aging

C55

AGE-RELATED DIFFERENCES IN THE EFFECTS OF AUTOMATIC AND DELIBERATE EMOTION REGULATION: A FUNCTIONAL MAGNETIC RESONANCE IMAGING INVESTIGATION Sanda Dolcos[1], Keen Sung[1], Ekaterina Denkova[1], Kristina Suen[1], Jessica Li[1], Roger A. Dixon[1], Florin Dolcos[1]; [1]University of Alberta, Canada — Emotion regulation (ER) undergoes lifespan transformations, with an apparent peak in efficiency occurring in older adulthood. Recent evidence suggests that healthy aging is associated with a "positivity bias" in processing emotional information, which is reflected in lower ratings of negative information. Given that this effect occurs even in the absence of explicit instructions to regulate emotions, it is possible that ER may operate automatically in older adults. However, little is known about the ER mechanisms involved and the associated neural correlates. We investigated this issue by comparing the effects of automatic/implicit and deliberate/explicit forms of ER in healthy younger and older adults. The experimental design manipulated both the goal to regulate emotion (implicit vs. explicit) and the intensity of the emotional challenge (high vs. low). Participants rated the emotional content of negative and neutral pictures, while brain activity was recorded using fMRI. Following a baseline run, subjects were instructed or nonconsciously primed to suppress responses to pictures varying in emotional content. Older adults had lower emotion ratings even during the baseline, and this effect was maintained following implicit ER manipulation. In contrast, for young adults a reduction in ratings occurred only after the ER induction. Consistent with these findings, fMRI data in older adults (N=15) showed automatic engagement of cognitive control regions (medial PFC) without ER manipulation, whereas in young adults (N=21) this engagement occurred only after explicit ER manipulation. The results shed light on possible mechanisms associated with the automatic ER underlying the positivity bias in healthy aging.

Emotion & Social: Emotion-Cognition Interactions

C56

THE EFFECT OF INDIVIDUAL VARIATION IN TRAIT SOCIAL ANXIETY ON THE NEURAL CORRELATES OF THE RESPONSE TO TRANSIENT ANXIETY-INDUCING EMOTIONAL DISTRACTION Florin Dolcos[1], Ekaterina Denkova[1], Gloria Wong[1], Sanda Dolcos[1], Nick Coupland[1]; [1]University of Alberta — Previous investigations linked individual differences in general cognitive abilities to variation in the response to general emotional distraction. Here, we investigated the relationship between individual variation in specific personality traits linked to emotional responses (i.e., social anxiety [SA]) and brain activity to transient SA-inducing distraction. Event related fMRI data were recorded while 15 healthy subjects performed a working memory (WM) task with angry face distracters presented during the delay between the memoranda and probes; trait SA was also measured with the Liebowitz Social Anxiety Scale (LSAS). Analyses focused on brain regions sensitive to processing emotional facial expressions and experiencing the associated feelings (fusiform gyrus [FG], amygdala [AMY] and medial prefrontal cortex [mPFC]) and brain regions associated with cognitive control (dorsolateral PFC [dlPFC]). We found evidence for dissociable effects of transient SA-inducing distraction on brain activity associated with the subjective vs. objective response to emotional distraction, which were linked to individual variation in trait SA and WM performance. Specifically, anxiety-inducing distraction enhanced activity in FG, AMY, and mPFC while disrupting it in dlPFC. Moreover, FG and mPFC activity showed positive correlations, while dlPFC activity showed negative correlations with LSAS scores, possibly reflecting individual variation in the subjective response to emotional distraction. However, only FG activity was also negatively correlated with WM performance, thus reflecting individual variation in the objective impact of emotional distraction on WM performance. Our findings suggest dissociable roles of these brain regions in the subjective response to task-irrelevant emotional distraction and its actual impact on cognitive performance.

C57

IT'S IN THE CARDS: AN FMRI STUDY OF PROBABILISTIC CLASSIFICATION LEARNING WITH EMOTIONAL AND NEUTRAL OUTCOMES Steven Prince[1], Laura Thomas[2], Philip Kragel[1], Steven Green[1], Kevin LaBar[1]; [1]Duke University, Center for Cognitive Neuroscience, [2]National Institute of Mental Health, Mood and Anxiety Program — A variation of a standard probabilistic classification task (weather prediction task) was used to investigate the neural correlates associated with feedback based learning. Two groups of participants viewed cue cards that varied in a probabilistic manner in predicting one of two outcomes. For Group 1, the outcomes were neutral (flowers/mushrooms) and for group 2, the outcomes were emotional (snakes/spiders). Group 2 subjects were given a phobic scale inventory to assess for individual differences in fearfulness. Participants were scanned at 4T and completed 2 runs of 50 trials each. To minimize the impact of different outcome pictures, trials were modeled separately for the cue and outcome portions. Consistent with behavioral results of previous studies, reaction times (RT) became significantly faster over training blocks. Evidence for learning on this task was revealed by a significant correlation between the change in RT and the change in performance across runs. In a model that used RT as a parametric regressor, faster RTs were associated with increased activation level in the caudate nucleus. In a direct comparison, this effect was greater for the neutral compared to the emotional group. Finally, in a simple regression model, activation level in the caudate nucleus was negatively correlated with phobic scores. Together, these results provide evidence for an impact of emotional outcomes on striatal activation level and suggest that individual differences in outcome salience further modulate feedback learning circuitry.

C58

RECOGNIZING REWARDS: SEARCHING FOR INCENTIVES IMPROVES SOURCE MEMORY ACCURACY Daniel Dillon[1], Oliver Hager[2], Diego Pizzagalli[1]; [1]Harvard University, [2]University of Zurich — Research on the cognitive neuroscience of reward encoding and reward-guided decision making has grown rapidly and provides insight into anhedonia, a symptom of multiple forms of psychopathology. However, this work has largely overlooked possible contributions of memory to reward processing. This is important because in some cases anhedonia may be linked with reward-related retrieval deficits. To begin to address this issue, we used a cue-framing approach to investigate recognition memory for rewards. Thirty-six healthy adults encoded 80 items. Each item was paired with one of two outcomes, either 25 cents (a reward) or 0 cents (a "zero"). Memory for item-outcome associations was tested by re-presenting the old items and 40 lures under one of two recognition cues, either "Reward?" or "Zero?". Participants made yes/no recognition judgments and confidence ratings. The primary hypothesis was that, although both cues direct participants to retrieve item-outcome associations, the "Reward?" and "Zero?" cues should prompt searches for reward and zero encoding traces, respectively. Because rewards elicit stronger affective and neural responses than zeros, source memory was expected to improve under the "Reward?" cue. This hypothesis was supported. For new items and items paired with zeros, accuracy improved under the "Reward?" cue relative to the "Zero?" cue. However, accuracy for rewarded items did not differ by cue. Finally, reaction times were faster under the "Reward?" cue across all sources. Results indicate that searching for rewarded encoding traces can improve source memory, and suggest that investigating reward-related retrieval deficits may illuminate a previously overlooked route to anhedonia.

C59

NEURAL MECHANISMS OF FEAR GENERALIZATION Kevin LaBar[1], Joseph Dunsmoor[1], Philip Kragel[1], Vishnu Murty[1], Steven Prince[1]; [1]Duke University — The ability to generalize learned behaviors across separate but similar stimuli is typically considered an adaptive function. Stimulus generalization can prove maladaptive, however, when previous learning is applied towards inappropriate stimuli. The maladaptive nature of stimulus generalization is perhaps best demonstrated by the overgeneralization of learned fear responses. To investigate the neural mechanisms involved in fear generalization, we adapted a novel conditioned fear generalization paradigm (Dunsmoor, Mitroff, & LaBar, 2009) for use with event-related fMRI. During fear conditioning, participants received pairings of a face expressing moderate fear intensity (CS+) with an electrical shock unconditioned stimulus as well as a control stimulus (neutral face of the same identity) that was explicitly unpaired. The generalized stimuli were gradations of the same individual's facial expression morphed incrementally between 100% neutral and 100% fearful endpoints. All faces were presented prior to conditioning to measure baseline responses as well as after conditioning in a steady-state generalization test. Fear learning and generalization were assessed by measuring skin conductance response. Behavioral results showed a fear generalization gradient along the dimension of emotional expression that peaked at a more intense value than the CS+. Analysis of fMRI responses during the generalization test showed two patterns of activity -- activity in the insula increased with the emotional intensity of the generalized stimuli whereas the ventromedial prefrontal cortex and bilateral parahippocampus showed a decreasing gradient of activity. These results suggest that distinct neural circuitry signals the generalization and control of learned fear responses.

C60

BEYOND HUMAN DESIRE: AN FMRI META-ANALYSIS Stephanie Ortigue[1], Francesco Bianchi-Demicheli[2], Chris Frum[3], James Lewis[3]; [1]Syracuse University, Upstate Medical University, Syracuse, New York, [2]University Psychiatric Centre, Geneva University Hospital, Geneva, Switzerland, [3]Center for Neuroscience, West Virginia University, Morgantown — While a fundamental aspect of human social behavior is the ability to feel desires towards other people, little is known about the nature of sexual desire. How does sexual desire differ from other biological drives, such as love or aesthetic attractiveness? The answers to these questions are not trivial. For decades, confusion between these three concepts (sexual desire, love, and aesthetic attractiveness) has been rampant. Despite the astonishing advances in neuroimaging techniques, there is a lack of direct comparison between the brain networks mediating these three concepts. Using a meta-analysis of functional brain images derived from 53 paradigms including a total of 615 participants, we unraveled the uniqueness of sexual desire (vs. love and physical attractiveness). the reported group-averaged data from each paradigm were all converted to a common Talairach coordinate space (AFNI-Talairach). Activation volumes were approximated by spheres and then projected into a brain volume space using AFNI software. These volumetric data were then projected onto the PALS (Population-Average, Landmark and Surface-based) atlas cortical surface models (left and right hemispheres). Results revealed sexual desire specifically involves the left inferior parietal lobule, bilateral caudal-anterior insula and occipital-temporal cortex--three main areas mediating subjective feelings, self-representation, and self-consciousness. The specific involvement of brain regions involved in self-representation during sexual desire reinforces the importance of body awareness in desire, and suggests that one may feel desires for other people based on past bodily self-reinforced experiences. This finding opens critical avenues for better understanding of the neurobiology of the desiring mind.

C61

RIGHT HEMISPHERE ADVANTAGE IN MEMORY FOR FACES PRESENTED IN EMOTIONAL BUT NOT NEUTRAL SCENES Shahnaz Koji[1], Myra A. Fernandes[1]; [1]University of Waterloo — Research has identified a right hemisphere advantage in memory for faces. In the real world, we encounter individuals within a visual scene or context, often laden with emotion, and this may influence memory performance. The current study examined the hemispheric memory advantage for faces when these are presented within an emotional scene. During an encoding phase, neutral faces were presented on either the left or right half of a computer monitor, and were embedded within emotional (positive, negative) or neutral scenes, which spanned the entire computer monitor. At test, old and lure faces were presented centrally on a white screen in a recognition memory test. Memory for faces initially presented in left space (processed in the right hemisphere) was significantly higher compared to memory for faces presented in right space, when the context was of an emotional scene. No hemispheric advantage was observed for faces presented in neutral contexts. Results demonstrate that the right hemisphere advantage for face memory was present, but only when faces were encoded within emotional scenes, suggesting that emotional valence of the context in which a face is encountered influences hemispheric advantages in later memory performance.

C62

IMPLICIT AND EXPLICIT LEVELS OF ANIMACY PERCEPTION IN ADULTS WITH HIGH FUNCTIONING AUTISM Bojana Kuzmanovic[1], Leonhard Schilbach[1], Alexandra L. Georgescu[1], Natacha Santos[1], Kai Vogeley[1]; [1]University of Cologne, Germany — While adults with high-functioning autism (HFA) are able to acquire an explicit understanding of other persons' minds, they still show impairments in the ability to read minds implicitly and intuitively. Animations of geometric shapes provide a possibility to investigate the perception of animacy defined as implicating a mind 'behind' moving objects. Particularly subtle qualities in movement patterns of the geometric shapes might convey the critical difference between rather personal or 'mindful' and rather physical or 'mindless' movements. Using such animations incorporated in an event-related functional magnetic-resonance-imaging paradigma, we focused on the differences in the neural and behavioral correlates of the perception of animacy between individuals with HFA and healthy control persons. Assessments of the animations on a four-point rating scale showed a less pronounced ability to differentiate between 'mindful' and 'mindless' animations in the HFA group only for ambiguous stimuli. In parallel with the behavioral results, a differential decrease of neural activity was present in the anterior cingulate gyrus and the fusiform gyrus in the HFA as compared to the control group only for ambiguous movement patterns. Taken together, our results indicate that animacy perception does not differ significantly between HFA and control participants when obvious movement patterns allow explicit, rule-based reasoning. Only when confronted with ambiguous cues that require intuitive processing, HFA participants demonstrated reduced differentiation on the behavioral level and a weaker activation in neural regions associated with sensory and evaluative processing of social cues.

C63

INFLUENCE OF PEERS ON SOCIAL BEHAVIOR AND UNDERLYING NEURAL CIRCUITRY Rebecca M. Jones[1], Leah H. Somerville[1], Erika J. Ruberry[1], Victoria G. Libby[1], Jaclyn Jeffrey-Wilensky[1], B. J. Casey[1]; [1]The Sackler Institute for Developmental Psychobiology, Weill Cornell Graduate School of Medical Sciences — The presence of peers has been associated with increases in risk-taking behavior. It has been hypothesized that peers alter such behavior because they act as secondary reinforcers; however, this hypothesis has not been directly tested. We used a task that parallels human and nonhuman primate studies of reinforcement learning to determine whether peers act as secondary reinforcers to bias adult behavior and neural activity. During fMRI scanning, participants saw pictures of three age-matched peers who passed notes to them at varying probabilities (33%, 66%, 100%). Participants were instructed to press a button when they saw the face of a peer, prior to receiving feedback of whether they received a note from that peer. fMRI analyses allowed for the direct comparison of receiving reinforcement in the form of a note from a peer versus not, and determining whether the varied expectation of receiving reinforcement altered neural activity. Behavioral results showed that participants were significantly faster to respond to faces of peers who interacted with them more (66%, 100%) and slower to peers who interacted with them less (33%). Similar to prior studies using money and juice as reinforcers, imaging results showed that reward circuitry, including ventral striatum and ventral medial prefrontal cortex (vmPFC), were activated when participants received peer interaction in the form of a note. Subsequent analyses revealed the vmPFC was sensitive to whether the interaction was expected or unexpected based upon the interaction history with each peer. These results suggest that peers influence behavior by acting as secondary reinforcers.

C64

SPATIAL ATTENTION MODULATION WITH UNMASKED FEARFUL FACES: DELAYED DISENGAGEMENT Karen Reinke[1], Josh Carlson[2], Amy Quarton[1]; [1]University of Illinois Springfield, [2]State University of New York at Stony Brook — Previous work has shown that spatial attention can be modulated with masked fearful faces by speeding the orienting rather than delaying the disengagement of attention. The goal of the current work was to examine attentional orienting and disengagement effects using the same set of faces, but unmasked presentation. A dot-probe paradigm was used. Participants viewed two face stimuli for 250 ms, one left and the other right of fixation. These were immediately replaced by a target dot presented in either location. Reaction times to the target were the dependent measure. There were three trial types. Congruent: one fearful face and one neutral face with the target appearing in the location of the fearful face. Incongruent: one fearful face and one neutral face with the target appearing opposite the fearful face. Baseline: both faces were neutral and the target could appear in either location. Participants responded significantly slower to incongruent than congruent trials. Additionally, participants responded significantly slower on incongruent than baseline trials while there was no difference between congruent and baseline trials. Given that baseline trials should not affect attention (both faces are neutral) and there wasn't a significant difference from congruent reaction times, this suggests that there was not an affect of orienting attention to unmasked fearful faces. However, the difference between baseline and incongruent trials suggests that reaction times are slowed during incongruent trials due to delayed disengagement from the spatial location of the fearful face to that of the target dot.

C65

ERPS OF EMOTIONAL IMAGES Alana Campbell[1], Deana Davalos[1], Mike Kisley[2], Barbara Banz[1]; [1]Colorado State University, [2]University of Colorado at Colorado Springs — Responses to emotional stimuli can be influenced by valence and magnitude. Brain responses to categorization of these stimuli are seen in a robust late positive potential wave. Recent evidence suggests that the amplitude of these waves can be influenced by the framing of the emotional conditions. These framing techniques were considered with personality factors to explain patterns of activation in response to emotional images. Participants' brainwaves are recorded in response to positive, neutral and negative images. Participants are split into two conditions; the positive condition must respond if the image viewed is positive or not while the negative are asked if the image is negative are not. Participants completed a battery of personality questionnaires. Comparisons between the groups are made based on changes in amplitude and latency of the late positive potential wave for the three types of images. Preliminary results suggest that framing and degree of extraversion may significantly alter the amplitude of ERPs.

C66

SHARPER SOCIAL SIGHT: ACUTE THREAT PERCEPTION CONTRIBUTES TO NEGATIVE INTERPRETATION BIAS IN SOCIAL ANXIETY David Rozek[1], Emily Cahill[1], Wen Li[1]; [1]University of Wisconsin-Madison — A hallmark symptom in social anxiety is negative interpretation biases that describe the tendency to judge neutral or ambiguous information as negative. The mechanisms underlying negative interpretation bias remain unclear: a primary proposition is that anxiety promotes negative high-level evaluative operations. We posit that early sensory perception of threat, which can be facilitated in anxiety to the extent that anxious individuals readily detect miniscule amounts of threat information often missed by non-anxious people, resulting in negative interpretations. Thus, we conducted two brain electrophysiological event-related potential (ERP) studies among pre-selected high- and low-anxious participants. The first study presented a neutral face and a face containing small amounts of fear (15%) simultaneously in the left and right visual fields, followed by a dot-probe task (N=37). Occipital P1, a primary visual ERP, demonstrated reliable discrimination between neutral and micro-fear faces ($T=2.10$, $P < 0.05$). The second study applied psychophysics in an affective judgment task, wherein participants were presented with a neutral face or a face containing small percentages of fear or disgust (6-30% in 4% increments) and reported whether the face was neutral or negative. A sigmoid-function was fitted on behavioral responses and P1 mean amplitudes at different percentages of fear/disgust. Furthermore, the percentage corresponding to the inflection point of the sigmoid-curve (detection threshold) for each participant was submitted into a correlation analysis with questionnaire measures of anxiety. A negative correlation between the detection threshold and anxiety scores would support our hypothesis of superb threat perception in anxiety that drives negative interpretations.

C67

EFFECTS OF FEAR EXPRESSIONS ON EYE GAZE PERCEPTION Daniel H. Lee[1], Joshua M. Susskind[1], Adam K. Anderson[1]; [1]University of Toronto — Evidence suggests that our facial expressions originated for sensory regulatory function (Susskind et al., 2008). For example, wider eye-opening in fear expressions is associated with a subjectively larger visual field and enhanced peripheral stimulus detection. Here we examined the Functional Action Resonance hypothesis (Susskind et al., 2008), which predicts that fear expressions' direct benefits for the sender have parallel indirect consequences for how receivers perceive and respond to their environment. Using schematic eye gazes that represent actual wider "fear" and narrower "disgust" eyes, without the remainder of the emotional expression, we examined the effects of eye aperture on gaze perception and target detection. Participants making forced-choice response judgments of left vs. right gaze direction responded more accurately with the increasing eye aperture characteristic of fear expressions. In a Posner-cuing paradigm where gaze matched or mismatched the location of a target, participants responded faster to the eccentric target when viewing fear eyes. These benefits appear due to the enhanced physical signals emitted by wider fear eyes, independent of emotional content, as similar effects were found with schematic boxes that were not perceived as eyes. Consistent with the Functional Action Resonance hypothesis, these results demonstrate a link between how emotions are expressed on the face and their influences on an observer's behavioural and perceptual processes.

C68

JUDGEMENTS OF SOCIAL APPROPRIATENESS IN TOURETTE'S SYNDROME Helena Drury[1], Mary-Beth Young[1], Roxanne Barrett[1], Jeremy Stern[2], Shelley Channon[1]; [1]University College London, UK, [2]St George's Hospital London, UK — Tourette's syndrome (TS) is a neurodevelopmental disorder in which the core symptomatology consists of motor and vocal tics. It has been linked to a range of everyday problems including social difficulties and inappropriate behaviours, but these may be primarily attributable to comorbid psychiatric symptomatology. Brain regions thought to be disrupted in TS have been linked to social-emotional processing and executive functions. The present study compared adults with uncomplicated TS with a matched healthy control group on a faux pas task requiring judgements of social appropriateness, and an emotional self-disclosure task, both previously found to be sensitive to deficits in orbitofrontal lesion patients (Beer, Heerey, Keltner, Scabini, & Knight; Stone, Baron-Cohen, & Knight, 1998). The two groups did not differ on appropriateness of emotional self-disclosures, as rated by independent judges, although the TS group showed reduced awareness of the appropriateness of their disclosures. The TS group showed impaired detection of faux pas situations relative to the control group, which may reflect subtle difficulties in use of knowledge about social situations. Implications of the findings for our understanding of TS are considered.

C69

SOCIAL PERCEPTION THROUGH MOTION: GENDER EFFECTS Marina Pavlova[1], Michele Guerreschi[1,2], Samuel Krüger[1], Arseny Sokolov[1], Ingeborg Krägeloh-Mann[1]; [1]University of Tübingen Medical School, Germany, [2]University of Padua, Italy — The ability of humans to understand and explain other people's actions is of immense value for adaptive behavior and social communication. Gender differences are often evident in the visual processing of social signals, but the underlying basis for these differences is unclear. Combining visual psychophysics with magnetoencephalography, we assessed gender differences in social perception revealed through motion. The findings indicate that: (i) Gender affects accuracy of body language reading. This effect, however, is modulated by emotional content of actions. Females are better tuned to the lack of emotions in body actions; (ii) Manipulation of gender stereotype messages affects visual social cognition. This effect is more pronounced in females, with a greater force of a negative stereotype message; (iii) Contrary to popular wisdom, gender effects are not evident in the network engaged in visual social interaction represented by motion of geometric shapes, but in the regions engaged in perceptual decision making. Taken together, the findings provide novel insights into understanding of gender effects in social cognition, and shed light on the interplay between socio-cultural and neurobiological factors.

C70

NETWORK DYNAMICS OF THE MESOLIMBIC DOPAMINE SYSTEM DURING HUMAN REWARD ANTICIPATION: A DCM STUDY Ian Ballard[1], Vishnu Murty[1], Jeff MacInnes[1], R. Mckell Carter[1], Scott Huettel[1], R. Alison Adcock[1]; [1]Duke University — We used effective connectivity and fMRI to investigate the dynamic network structure of a subset of the human reward system (including the ventral tegmental area (VTA), nucleus accumbens (NAcc), and left inferior frontal gyrus (IFG)). Specifically, this study addresses whether the VTA, a source of dopamine the in brain, or the left IFG, which has been implicated in the conscious representation of reward, drives the reward system during anticipation of reward. We used Dynamic Causal Modelling (DCM) to explore this question. This technique specifically models fMRI data in regions of interest (ROIs) as a set of interconnected nodes whose connections can change strength in different experimental contexts. Additionally, we implemented Bayesian model selection to compare models with different driving inputs and connection structure. Models with the best fit indicated driving inputs to the LIFG rather than the VTA. Thus, information about upcoming reward is first evident in the LIFG and then propagates through the network via reward-enhanced connections to the VTA and NAcc. The VTA-NAcc loop has both the strongest intrinsic connections and the strongest increase in effective connectivity during the reward context. Both of these regions have connections terminating in the left IFG that are significantly enhanced during reward processing. Together, these findings suggest that the left IFG initiates processing of reward cues in the strongly coupled Nacc and VTA, which in turn provide feedback to the IFG. This is the first study to directly address the question of how these regions dynamically interact during reward anticipation.

C71

REACTIVE AND PROACTIVE CONTROL OF EMOTIONAL INFORMATION IN HIGH AND LOW TRAIT ANXIOUS INDIVIDUALS Marie Krug[1], Cameron Carter[1]; [1]University of California, Davis — While conflict inducing tasks such as the color-word Stroop produce characteristic behavioral and neural responses, the behavioral and neural underpinnings of response conflict tasks involving emotional stimuli, and their modulation by individual differences in trait anxiety, are less well understood. We manipulated subjects' expectancies for congruent and incongruent trials during performance of an emotional Stroop task. Subjects judged whether a face was neutral or fearful in emotion while ignoring a superimposed word ("fearful" or "neutral") that could be either response congruent or response incongruent. For the high expectancy block, 65% of trials were incongruent to encourage a proactive control strategy, while in the low expectancy block, only 35% of trials were incongruent to induce a reactive control strategy (Braver et al., 2007). Our behavioral results replicated previous findings using non-emotional Stroop tasks (Carter et al., 2000), showing that interference is reduced, in both reaction time and accuracy, for the high expectancy block in comparison to the low expectancy block. Analysis of the effects of individual differences in trait anxiety showed that high anxious (HA) subjects' attempts to reduce behavioral interference in the high expectancy task were differentially successful depending on trial type. HA subjects showed evidence of increased conflict during incongruent neutral face/fearful word trials preceded by congruent trials when control was "proactively" engaged during the high expectancy condition. fMRI analysis will test the hypothesis that increased conflict with emotional distraction in HA individuals is associated with reduced activation in the prefrontal cortex and increased activity in the anterior cingulate.

C72

DEPRESSION, RUMINATION, AND THE DEFAULT NETWORK Marc Berman[1], Scott Peltier[1], Derek Nee[2], Ethan Kross[1], Patricia Deldin[1], John Jonides[1]; [1]The University of Michigan, [2]Indiana University — Previous research indicates that Major Depressive Disorder (MDD) is characterized by excessive default network activation and connectivity in the subgenual-cingulate. Hyper-connectivities are often interpreted as reflecting excessive self-focused rumination, in which MDDs perseverate on negative, self-referential thoughts. However, no prior research has examined how connectivity in this network covaries with individual differences in rumination and whether these differences persist when participants are distracted by a task. Neural functional connectivity between the posterior-cingulate cortex and the subgenual-cingulate cortex was explored in 15 MDDs and 15 Healthy Controls (HCs) during rest periods and short-term memory task periods using a seed-based connectivity approach. MDDs showed more neural functional connectivity between the posterior-cingulate cortex and the subgenual-cingulate cortex than healthy individuals during rest periods, but not during task engagement itself. Additionally, scores on a standardized scale of depressive rumination correlated positively with the amount of connectivity between the subgenual-cingulate and posterior-cingulate during rest periods across all participants.

C73

DISSOCIABLE ROLES FOR EMPATHY AND SYMPATHY IN WILLINGNESS TO SHARE: AN FMRI STUDY K. Richard Ridderinkhof[1], Johannes Fahrenfort[1], Ben Pelloux[2], Frans van Winden[2]; [1]Acacia, University of Amsterdam, [2]CREED, University of Amsterdam — Willingness to share monetary benefits has been argued to relate to empathy. Empathy involves activation in neural networks including most prominently the anterior insula (AI) and anterior cingulate cortex (ACC). Sympathy, or caring about the interests of others based on positive interactions with those others, involves activation in neural networks including most prominently the superior temporal sulcus (STS) and posterior cingulate cortex (PCC). Here we show that willingness to share monetary benefits increases after positive interaction in a public goods game, and that this increased willingness to share is predicted by activation of the STS and PCC. Activation of the AI and ACC did not predict willingness to share, not even for people scoring high on empathy scales. These patterns suggest dissociable roles for empathy and sympathy in one's willingness to share monetary benefits with others.

C74

TRAIT ANXIETY MODULATES THE NEURAL EFFICIENCY OF ATTENTIONAL CONTROL Ulrike Basten[1], Christine Stelzel[1], Christian J. Fiebach[1]; [1]University of Heidelberg, Germany — In the current study, we used fMRI to investigate whether or not the neural efficiency of attentional control processes is modulated by trait anxiety. An impairment of attentional control in the face of threat-related distractors is well established for high-anxious individuals. Beyond that, it has been hypothesized that high trait anxiety more generally impairs the neural efficiency of cognitive processes requiring attentional control – even if the task at hand does not contain threat-related stimuli (Eysenck et al., 2007). We assessed anxiety in 46 subjects (using the State-Trait Anxiety Inventory) and examined the correlation of trait anxiety with brain activation and functional connectivity, for incongruent as compared to congruent trials in a color-word Stroop task. High- as compared to low-anxious individuals showed stronger activation for the Stroop incongruency effect in the lateral prefrontal cortex (LPFC). In addition, we observed reduced functional connectivity of LPFC with the dorsal anterior cingulate cortex (dACC) and the so-called visual word form area in the left fusiform gyrus. Taken together, both the increased activation in a circumscribed region associated with attentional control and the decreased functional coupling of this region with other task-related regions support the assumption of reduced neural processing efficiency in anxious individuals. The stronger LPFC activation in anxious subjects is interpreted as an attempt to compensate for suboptimal coupling within the cortical network subserving Stroop task performance. Observing these effects in an affectively neutral task, we conclude that the impairment of attentional control in anxious people is indeed general and not threat-specific.

C75

THE EFFECTS OF NEGATIVE EMOTION ON SPATIAL AND VERBAL WORKING MEMORY Pan Liu[1,2], Renlai Zhou[1,3,4]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, China, [2]School of Communication Sciences and Disorders, McGill University, Montréal, [3]Key Laboratory of Child Development and Learning Science, Southeast University, Nanjing, China, [4]Beijing Key Lab of Applied Experimental Psychology, Beijing Normal University, China — To explore the effects of negative emotion on spatial and verbal working memory (WM), we manipulated participants' negative arousal level (high, low) in relation to their WM task load (high, low). The International Affective Pictures System (IAPS) was used to induce different levels of negative arousal, and the Delayed Match to Sample Task was used to modulate WM task load. Both behavioral and Event Related Potentials (ERP) data were analyzed. Results showed that negative emotion selectively affected spatial but not verbal WM; one reason for this pattern is that emotions induced by the IAPS were little involved with verbal processes, but overlapped with visual-spatial resources. Furthermore, on spatial WM there was a significant interaction between negative arousal and task load. High negative arousal impaired spatial WM in the task with high load, but facilitated spatial WM in the low load task. In contrast, low negative arousal facilitated spatial WM task of high load, but had no effects on that of low load. These effects were revealed by both accuracy and three ERP components, P2, P350, N2, which were considered to reflect the stages of attention allocation, attention maintenance, and executive control of spatial WM process, respectively. Our results demonstrate that both negative arousal and WM task load affect spatial WM, perhaps due to competition for visual-spatial attention resources. Moreover, this interaction is a successive and dynamic process involving different cognitive stages, as reflected in different ERP components.

C76

HUMAN FRONTAL BETA ACTIVITY FOR MONETARY REWARD MOTIVATION INCREASES VISUAL WORKING MEMORY CAPACITY Masahiro Kawasaki[1]; [1]RIKEN, BSI-Toyota Collaboration Center — Human cognitive performance is influenced by several motivational changes. Previous studies have identified the midbrain dopaminergic system and limbic cortex for reward motivations and the fronto-parietal cortical networks for higher cognitive functions, such as working memory (WM). However, little is known about how these two systems are interacted. To address the issue, the present study investigated the electroencephalograph (EEG) oscillations during a monetary incentive WM tasks. In this task, the subjects were required to maintain several objects' colors (3 or 6) for a short retention interval (2sec), and if this trial is correct, they got the reward which value (0, 10, or 50 Japanese yen) was indicated before each trial. Behavioral results showed that the WM capacity increased under the high monetary rewards, as compared with no or low rewards. EEG results showed that the frontal beta activity increased when the positive feedback signal was presented (i.e. the subject's answer is correct) and subjects confirmed receiving reward values, relative to no reward condition. This result indicates the involvement of the beta local synchronizations in reward system. Moreover, the parietal alpha activity significantly varied among the numbers of the presented objects during retention interval under no reward condition, which is consistent with previous findings that the parietal activity related to the WM capacity. Interestingly, under high reward conditions, the frontal beta activity alternatively increased during retention interval. These results indicated that the interactions between the beta and alpha activities would be associated with increasing WM capacity under high reward motivations.

C77

PLEASANT STIMULI FACILITATE LEXICAL DECISIONS-AN EEG STUDY Johanna Kissler[1], Susanne Koessler[1]; [1]University of Konstanz — We investigated the influence of briefly (100 ms) presented pleasant and unpleasant emotional pictures on a subsequent lexical decision in an affective priming task. Reaction times, error rates, and brain event-related potentials (ERPs) were analyzed. In the behavioural data, two independent main effects emerged: Subjects responded faster and more accurately to pleasant adjectives. Moreover, pleasant pictures also accelerated the subjects' responses. In the stimulus locked ERP, the centro-parietal N400 in response to the target words showed the well-known pseudo-word effect, but was insensitive to the valence of either the primes or the targets or their interaction. In the response locked ERPs, an effect of target valence was observed with a larger readiness potential preceding responses to pleasant words. Overall, in line with some other previous studies of affective priming using the lexical decision task, no congruency effects emerged. However, in general pleasant stimuli facilitated lexical decisions. This facilitation apparently at least partly by-passed full semantic analysis and acted rapidly on response preparation.

C78

REMEMBERING BEAUTY: ROLE OF ORBITOFRONTAL CORTEX IN SUCCESSFUL MEMORY ENCODING OF ATTRACTIVE FACES Takashi Tsukiura[1], Roberto Cabeza[2]; [1]Tohoku University, [2]Duke University — Humans display a strong preference for attractive faces, and this bias can be observed even in infant babies. Attractive faces also have a processing advantage in various social and cognitive domains, including memory. Although these effects are well established, the underlying neural mechanisms are largely unknown. In the current study, we used event-related functional MRI (fMRI) to investigate the effect of attractiveness on memory for faces. Female participants were scanned while rating the attractive of male faces, and after scanning they performed an old/new recognition test with confidence ratings. Using the subsequent memory paradigm, encoding success activity (ESA) was identified by comparing study-phase activity for faces that were subsequently remembered (hits) vs. forgotten (misses). As expected, attractive faces were remembered better than unattractive faces. fMRI analyses yielded three main findings. First, in the medial orbitofrontal cortex (OFC), ESA was greater for attractive faces than for unattractive faces. This effect occurred for high- but not for low-confidence responses, suggesting it is linked to recollection rather than to familiarity. Second, ESA for high-confidence responses was found in the hippocampus across levels of facial attractiveness. Finally, ESA in OFC and the hippocampus were significantly correlated across all levels of attractiveness. Taken together, these findings suggest that better memory for attractive faces reflects the interaction between a region previously associated with processing reward, the OFC, and a region associated with successful encoding and recollection, the hippocampus.

C79

BRAIN MECHANISMS UNDERLYING THE INTRUSIVE NATURE OF PREVIOUS EMOTIONAL ASSOCIATIONS Michiko Sakaki[1], Kazuhisa Niki[2], Mara Mather[1]; [1]University of Southern California, [2]National Institute of Advanced Industrial Science and Technology — In life, we must often learn new associations to people, places or things we already know. Recent studies indicate that learning new associations to old items is harder when those old items are either emotional themselves (Novak & Mather, 2009) or were previously associated with emotional items (Mather & Knight, 2008). The current study employed functional MRI to address the neural mechanism underlying this emotion-enhanced proactive interference. Nineteen participants learned associations between pictures and neutral objects or between pictures and encoding tasks in the first phase of the study. Half of the pictures were negative and the others were neutral. This first learning session was followed by a memory updating session, in which participants were presented with old pictures (i.e., pictures previously associated with tasks or objects) or new pictures (i.e., pictures that they had not seen in the first phase) and asked to memorize their location. We found a significant interaction between picture novelty and valence in the lateral orbitofrontal cortex. The lateral orbitofrontal cortex showed greater activity when participants attempted to learn the location of old emotional items than when they attempted to learn the location of novel emotional items. In addition, the orbitofrontal cortex was activated more when learning locations of old emotional items than old neutral items. Lateral orbitofrontal cortex is involved in inhibiting responses to previously rewarded stimuli in reversal learning paradigms (e.g., Elliott et al., 2000); our findings suggest that lateral OFC plays a more general role in updating associations to emotional stimuli.

C80

NEURAL CORRELATES OF TRAUMATIC MEMORY INCONSISTENCY IN POST-TRAUMATIC STRESS DISORDER Erin Dickie[1,2], Alain Brunet[1,3], Annie-Claude David[1], Vivian Akerib[1], Jorge Armony[1,2,3]; [1]Douglas Mental Health University Institute, [2]Integrated Program in Neuroscience, McGill University, Montréal, Quebec, [3]McGill University, Montréal, Quebec — In the treatment of Post-Traumatic Stress Disorder, it has been proposed that the completeness and consistency of patients' autobiographical memory for their traumatic event is an important clinical consideration. One quantifiable measure of traumatic memory inconsistency is the amount of change between testing sessions on scales measuring the subjective experience of the traumatic event such as the Peritraumatic Distress Inventory (PDI) and the Peritraumatic Dissociative Experience Scale (PDEQ). We recently reported that increased change on these two scales is associated with poorer clinical prognosis. We analysed functional and structural magnetic resonance imaging data collected from a subset of these patients (n=27) to identify the neural correlates of this memory inconsistency. Two neural markers were explored: 1) functional data collected while participants encoded emotional stimuli (fearful and neutral faces) into memory and 2) gray matter volume analysed using voxel based morphometry. Memory inconsistency was associated with increased left amygdala/hippocampus and decreased right ventral lateral prefrontal cortex (vlPFC) involvement in successful emotional memory encoding (Fearful [Remembered-Forgotten] – Neutral [Remembered-Forgotten] contrast). Additionally, memory inconsistency was associated with decreased gray matter volume in the right anterior insula and bilateral posterior cingulate cortex. These findings suggest that long-term traumatic memory inconsistency may be a marker of dysfunctional activity of brain structures thought to be critical for emotional memory encoding. These results also suggest a cognitive mechanism by which known decreases in gray matter volume in PTSD patients may contribute to PTSD pathology.

C81

THE EFFECT OF RETRIEVAL FOCUS DURING RECOLLECTION OF AFFECTIVE AUTOBIOGRAPHICAL MEMORIES: A FUNCTIONAL MAGNETIC RESONANCE IMAGING INVESTIGATION Ekaterina Denkova[1], Trisha Chakrabarty[1], Kristina Suen[1], Sanda Dolcos[1], Florin Dolcos[1]; [1]University of Alberta, Canada — One of the core debilitating features of mood disorders is ruminating on negative autobiographical memories (AMs). Although there has been significant progress in understanding the brain mechanisms underlying AM retrieval, little is known about how focusing on vs. distracting from the emotional content during recollection of life experiences might influence the subjective re-experience of AM and the associated neural correlates. The present study investigated this issue by manipulating the retrieval focus while healthy participants recollected AMs and fMRI data were recorded. Participants were asked to retrieve forty AMs and to focus either on emotional (Emo condition) or non-emotional (e.g., spatial) contextual aspects (NonEmo condition); cues for these memories were collected prior to scanning by means of an AM questionnaire. Preliminary analyses of data from 10 participants showed that Emo condition was associated with increased subjective experience of emotion and enhanced activity in limbic regions (e.g., the amygdala and anterior cingulate cortex). By contrast, the NonEmo condition was linked to decreased self-reported affect and diminished activity in the amygdala, coupled with enhanced activity in brain regions associated with processing of spatial information (parahippocampal gyrus) and inhibitory processes (ventrolateral prefrontal cortex). These findings suggest that distracting from emotion leads to effective inhibition of the feelings originally associated with AMs, and have relevance for understanding the negative affective bias observed in mood disorders (possibly linked to a failure to inhibit negative aspects of AMs). These findings also provide support for cognitive behavioural therapies involving training to distract from emotional aspects of personal memories.

C82

RELEVANCE DETECTION AS A KEY DETERMINANT OF MEMORY FACILITATION FOR EMOTIONAL STIMULI Alison Montagrin[1,2], David Sander[1,2]; [1]Laboratory for the study of Emotion Elicitation and Expression, University of Geneva, Switzerland, [2]Swiss Center for Affective Sciences, University of Geneva, Switzerland — Several studies have shown that memory can be facilitated for emotional as compared to neutral stimuli. This modulation of memory has typically been explained in terms of two affective dimensions: valence and arousal. However, it is unclear whether these dimension represent necessary conditions for memory facilitation. In particular, an appraisal-based approach suggests that arousal is a typical response elicited by self-relevant stimuli, but that it is the appraised relevance of the stimuli that facilitate memory rather than the fact that these stimuli are arousing. With respect to valence, one can also argue that it is not the intrinsic valence of a stimulus (i.e. its pleasantness or unpleasantness) that is responsible for the memory-enhanced effect, but rather the motivational relevance of the stimulus (e.g., its goal-relevance). In this experiment, we aimed at testing the hypothesis according to which there is a memory facilitation for neutral stimuli that are goal-relevant. We used an incident task memory paradigm in which we manipulated the relevance of neutral stimuli. Participants were presented with two main conditions: a neutral stimulus (e.g., a chair) could be either relevant (i.e. goal-obstructive or goal-conducive) or irrelevant (i.e. neither goal-obstructive nor goal-conducive). Results showed that stimuli presented in the relevant condition were better recognized than those presented in the irrelevant condition. This memory effect was even stronger after a delay than during an immediate recognition task. These results suggest a long-lasting effect of a relevant event on memory, independently its intrinsic valence or arousing property.

C83

EPISODIC MEMORIES OF EMOTIONAL PHOTOGRAPHIC PICTURES: AN ERP COMPARISON BETWEEN MEN AND WOMEN Emma Glaser[2], Adrianna Mendrek[1,2], Emmanuel Stip[1,2], François Guillem[1,2], Marc Lavoie[1,2]; [1]Université de Montréal, QC, Canada, [2]Centre de Recherche Fernand Seguin, Louis-H Lafontaine Hospital, Montréal, QC, Canada — Context: It is commonly believed that men and women react differently to emotion. Women have been found to react more strongly to negative pictures than men, to be more sensitive to threatening stimuli, whereas men have been seen to be more sensitive to positive and erotic stimuli. Differences for emotional effects on memory have been recently studied through brain imaging techniques and Event-Related Potentials (ERP). However, comparisons between pleasant and unpleasant pictures were not balanced across arousal values. In addition, men and women were often mixed or studied separately. Goals: The current study aims at comparing men and women's emotional memory to photographic stimuli and explores ERP components of interest that are activated. Methods: ERP components were compared in 11 men and 16 women. ERPs were obtained from 56 EEG electrodes during the presentation of 200 pictures from the International Affective Picture System according to four categories (pleasant low arousal - unpleasant low arousal - pleasant high arousal - unpleasant high arousal). The episodic memory task was to identify pictures that had been seen previously (old) from those not yet been seen (new) by a button press. Results: From ERPs, the Late Positive Component showed that the episodic memory old-new effect in women was more important in the right hemisphere, while for the men, it was larger in the left hemisphere. Conclusion: Especially with women, emotional arousal affected memory significantly while valence did not and suggest that, between genders, different cerebral networks are involved in emotional memory processing.

Perception & Action: Multisensory

C84

THE RIGHT DORSAL OCCIPITAL STREAM MAINTAINS ITS FUNCTIONAL SPECIFICITY FOR SPATIAL PROCESSING IN ABSENCE OF VISUAL EXPERIENCE Olivier Collignon[1,2,3], Gilles Vandewalle[4,5], Patrice Voss[1], Geneviève Charboneau[1], Maryse Lassonde[1,2], Franco Lepore[1]; [1]Centre de Recherche en Neuropsychologie et Cognition (CERNEC), Université de Montréal, Canada, [2]Centre de Recherches CHU Sainte-Justine, Montréal, [3]Institute of Neuroscience, Université Catholique de Louvain, Belgique, [4]Unité de Neuroimagerie Fonctionnelle, Institut Universitaire de Gériatrie de Montréal, Canada, [5]Centre d'étude du sommeil de l'hôpital du Sacré Cœur de Montréal, Canada — Several studies have demonstrated that the occipital cortex of early blind individuals reorganizes itself and becomes massively involved in the processing of auditory information. However, it is still unclear whether the topographical functional organization observed in sighted individuals is maintained in the rewired occipital regions of early blind individuals. In the present fMRI study, 11 early blind and 11 matched sighted subjects were asked to process either the spatial location or pitch properties of sounds that were identical in both conditions. Groups (Blind > Sighted) by conditions (Spatial > Pitch) interactions analysis revealed that the spatial processing of sounds in blind participants selectively recruited the right dorsal occipital stream, in regions well known to be involved in visuo-spatial processing in sighted subjects. These results represent a compelling demonstration that the "dorsal occipital stream" is not only crossmodally recruited for the processing of sounds, but also maintains its functional role for spatial processing in the absence of any visual input since birth.

C85

A COMPUTATIONAL MODEL OF WORD LEARNING IN INFANCY: EARLY INTERACTIONS BETWEEN VISUAL AND AUDITORY PROCESSING ENABLE CATEGORICAL PERCEPTION Nadja Althaus[1], Denis Mareschal[1]; [1]Birkbeck, University of London — We introduce a computational model which simulates the interaction between auditory and visual processing that enables learning mappings between words and objects. The model's architecture consists of two self-organizing maps (Kohonen, 2001) representing the visual and auditory domain, interconnected by Hebbian links (Li et al., 2004). The maps are trained with pairs of words and objects. During training, input patterns in each domain produce activation patterns in the respective map. Hebbian links are established between co-activated map elements. Our analysis focuses on the differences between non-interactive and interactive training. In the non-interactive scenario, the Hebbian links develop passively, precluding cross-modal influences. In the interactive scenario, the Hebbian links propagate activation from both domains to the opposing map, producing indirect activation patterns. The combination of direct and indirect activation provides additional information which is exploited by the learning mechanism. By enhancing the activation in map areas co-activated by direct and indirect input, and inhibiting activation in areas activated only by direct input, the interactive model develops a qualitatively better representation of exemplar space than the non-interactive model. The representation emerging from interactive training exhibits the characteristics of categorical perception. This result is consistent with experimental findings of verbal labeling facilitating object categorization in infants (Waxman & Markow, 1995). Based only on unsupervised learning, the model presents a neurally plausible implementation of this facilitation effect. The results suggest that the label's strength are its cross-modal characteristics, which enable control over the relevance of visual features in category formation.

C86

THE NEUROANATOMY OF BODILY SELF-CONSCIOUSNESS: DISTINCT NEURAL CORRELATES FOR ILLUSORY OWN BODY PERCEPTIONS WITH AND WITHOUT DISEMBODIMENT OF NEUROLOGICAL ORIGIN Lukas Heydrich[1,2], Olaf Blanke[1,2]; [1]Laboratory of Cognitive Neuroscience, EPFL, Lausanne, Switzerland, [2]Presurgical Epilepsy Unit, University Hospital Geneva, Switzerland — The everyday sensation of spatial unity between body and self and the experience we have of identifying ourselves with this body may break down during illusory own body perceptions in neurological patients (Brugger et al., 1997). We have recently argued that the study of these neurological conditions and related experiments in healthy subjects is important for the development of a neurobiological model of self-consciousness (Blanke and Metzinger, 2009). Here, we studied lesion location in 24 patients suffering from one of the three major types of illusory own body perceptions (out-of-body experience, heautoscopy, autoscopic hallucinations) and compared them to a control group consisting of patients with complex hallucinations of bodies and faces without own-body illusions. The out-of-body experience was associated with damage to the right angular gyrus (centered on Talairach and Tournoux coordinates $x = 54$, $y = -52$, $z = 26$), heautoscopy was associated with lesions to the left posterior insula (centred on coordinates $x = -40$, $y = 1$, $z = -10$), and autoscopic hallucinations with the right occipital cortex (centred on coordinates $x = 20$, $y = -84$, $z = 20$). Given normality of bodily self-consciousness during autoscopic hallucinations (Blanke et al., 2004) these lesion findings confirm the importance of the right temporo-parietal junction in spatial and multisensory aspects of self-consciousness. The novel implication of the left insula in this patient population is compatible with its involvement in interoceptive, emotional, and motivational aspects of self-consciousness (Craig, 2009). Based on these data we propose an extended model of bodily self-consciousness.

C87

IS DURATION PROCESSING A SENSORY-INDEPENDENT (AMODAL) PROPERTY? John S. Butler[1,2], Sophie Molholm[1,2], Ian C. Fiebelkorn[1,2], John J. Foxe[1,2]; [1]City College of New York, [2]Albert Einstein College of Medicine — This study investigated whether pre-attentive duration processing is similar for different sensory modalities, and therefore shines a light on the question of whether duration is a sensory-modality independent property. To understand these processes, high-density electrical recordings were collected from subjects while they participated in an auditory alone and somatosensory alone duration mismatch paradigm. The MMN is an electrophysiological response to an oddball stimulus presented in a regular stream of stimulation, and the loci of its generators are believed to correspond with the representation of the eliciting feature. Subjects (n=8) viewed a silent movie while they were presented a stream of tones consisting of standard stimuli (200Hz, 50ms) and deviant stimuli (200Hz, 100ms). There were a total of 1200 standards and 400 deviants per block. The experiment was blocked by sensory modality and counterbalanced across participants. The mismatch waveforms were calculated by subtracting the standard evoked potential from the deviant evoked potential. The somatosensory mismatch had two distinct phases, firstly a negative amplitude peak at ~125ms followed by a positive amplitude peak at ~230ms. While the auditory mismatch had only one phase, a negative peak amplitude at ~234ms. Furthermore, there were very different scalp topographies at a latency of 236ms for the somatosensory and auditory mismatch. The findings show that the generators of the duration mismatch for auditory and somatosensory are not the same, implying that the processing of duration is modality independent.

C88

TEMPORAL CORTEX TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS) MODULATES COGNITIVE PERFORMANCE, VISUAL SEARCH, AND PUPIL DILATION Paulo Boggio[1], Claudia Valasek[1], Allan Snyder[2], Felipe Fregni[3]; [1]Mackenzie Presbyterian University, [2]University of Sydney, [3]Harvard Medical School — Recently, we showed that transcranial direct current stimulation (tDCS) is able to induce behavioral changes in tasks such as the Deese, Roediger and McDermott's paradigm (DRM). We showed that temporal tDCS induces a diminishment in semantic-based errors. Here, we aimed to investigate the effects of tDCS not only using behavioral measures, but also measuring pupil dilation, saccadic movements and time of fixation. Therefore, we conducted a double-blind, sham, randomized study in which 15 subjects, aged between 17 and 28 years, received active or sham tDCS over the superior temporal cortex. During tDCS, subjects performed the following tasks: a) letters detection, b) errors detection between pairs of pictures, and c) DRM task. All tasks were performed using an eye-tracking system (Tobii). With regard to the DRM task, we found the same behavioural effect (reduction on false memory errors). Interestingly, we found an increased pupil dilatation when subjects present mistakes by semantic association during active tDCS as compared to those who received sham tDCS. In the test of letters counting, active tDCS group found more letters in comparison to the sham group, but at the same time spent less time of fixation at the areas of interest. In the test of errors detection, the same results were observed: better behavioral performance in a lesser time of fixation. This study reinforces the evidence found in our previous study on the behavioral effects of stimulation, and extend it showing that tDCS interferes in the processes and strategies of visual search and pupil dilation.

C89

INTEGRATION OF AUDIOVISUAL SPEECH DOES NOT RELY ON BROCA'S AREA Jonathan Venezia[1], Feng Rong[1], Christopher Dale Maddox[1], Kourosh Saberi[1], Gregory Hickok[1]; [1]University of California, Irvine — Several lines of research suggest that auditory speech perception is influenced by visual speech. For example, auditory comprehension is improved by the presence of visual speech in noisy environments or when the auditory signal is degraded. It has been proposed that there are two potential sources of this visual influence: sensory-sensory interaction, whereby auditory and visual sensory signals are integrated directly, and sensory-motor interaction, whereby visual speech accesses motor representations that influence auditory perception. The neuroimaging literature has implicated the superior temporal sulcus (STS) and Broca's area as possible sites for sensory-sensory and sensory-motor interaction, respectively. The present fMRI experiment investigates whether both mechanisms are involved during perception of synchronous audiovisual speech. Subjects were presented with blocks of CV syllables in the following conditions: auditory speech alone (A), visual speech alone (V), and audiovisual speech (AV). Consistent with previous studies, all three conditions activated posterior STS bilaterally. A conjunction analysis of [AV-A] with [AV-V] revealed active voxels in STS showing a preference for multisensory information. However, while Broca's area was significantly active to auditory and visual speech alone, it was not active to audiovisual speech. These results suggest that audiovisual integration can take place without the sensory-motor mechanism. This is consistent with previous results suggesting an increased, top-down role for Broca's area when the sensory signal is difficult to resolve, e.g. when audiovisual speech is perceptually unfused, phonetically incongruent, or temporally offset. The properties of this top-down mechanism were further assessed using Granger causality and multivoxel pattern classification analyses.

C90

VISUAL PREDICTABILITY MODULATES NEUROMAGNETIC AUDITORY EVOKED RESPONSES TO SPEECH SYLLABLES Ariane E. Rhone[1], William J. Idsardi[1], David Poeppel[2]; [1]University of Maryland, College Park, [2]New York University — Previous work has established that auditory evoked responses N1 and P2 to audiovisual speech and nonspeech stimuli peak earlier than responses to the same auditory stimuli presented unimodally (van Wassenhove et al., 2005; Stekelenburg & Vroomen, 2007). For speech stimuli, it has been suggested that the amount of latency reduction (facilitation) for a particular segment is dependent on its visual predictability (i.e., bilabial segments like [b] are most visually distinct and show greatest facilitation). In this study, we aim to replicate the audiovisual facilitation effect and to test the hypothesis that visual predictability modulates the amount of facilitation. In a simultaneous MEG and behavioral identification task, participants (n=12) were presented with randomized auditory-alone and audiovisual stimuli in two blocks: BlockA contained [ba da ga] (where [ba] is visually distinct from [da ga] as reflected in RT and accuracy); BlockB contained [ba pa da] (where distinctness of [ba] decreases and [da] becomes most visually distinct within the set of alternatives in the block). If visual predictability modulates this effect, facilitation should be greatest for [ba] in BlockA and for [da] in BlockB. Alternatively, if increased facilitation is segment-specific, bilabials should have greatest facilitation in both blocks. Auditory M100 responses show latency reduction for audiovisual relative to audio-alone stimuli ($p<0.05$), with significantly greater facilitation for [ba] in BlockA and for [da] in BlockB. This suggests that the audiovisual speech perception process is flexible; the greater advantage previously shown for bilabials reflects relative visual predictability rather than a fixed, segment-specific property.

C91

DIFFERENTIAL EFFECTS OF MAGNIFIED VISION OF THE ARM ON TACTILE AND MOTOR TASKS Jared Medina[1], Jennifer Benson[1], H. Branch Coslett[1]; [1]University of Pennsylvania — Motivated by the previous demonstration that viewing one's hand magnified improves tactile two-point discrimination (Kennett et al, 2001), we addressed three issues regarding the effects of vision on tactile and motor function. First, we assessed the effect of magnification on a different measure of tactile acuity (grating orientation). Second, we assessed the effect of magnification on simple motor tasks. Third, we assessed the time course of tactile and motor changes. We presented subjects with three tasks (tactile grating orientation discrimination, speeded finger tapping, and grip strength) after viewing the hand minimized (.5x), magnified (2.2-2.5x) or with no manipulation. Furthermore, subjects either had 5 minutes or 30 minutes to view and use the hand before testing. In the short view condition, subjects demonstrated significant improvement with magnification on the tactile grating orientation task, but not the motor tasks. The opposite pattern was observed in the long view condition: a modest but significant improvement with the hands magnified on both motor tasks (finger tapping and grip strength), but no change in tactile grating orientation task. Analyses revealed significant interactions between magnification and viewing conditions for all three tasks. Inconsistent results were observed in the minimization conditions. These data extend the findings of effects of visual-tactile interactions by revealing magnification induced enhancement with a different paradigm and demonstrate that magnification of the hand can influence motor function on tasks for which vision is not needed. Finally, the data suggest that visuo-motor and visuo-tactile interactions have different time courses.

C92

THE DEVELOPMENT OF AUDITORY-SOMATOSENSORY MULTISENSORY INTEGRATION IN CHILDREN BETWEEN THE AGES OF 6 AND 17 YEARS: A HIGH-DENSITY EEG STUDY Sophie Molholm[1,2,3], Natalie Russo[1,2], Alice B. Brandwein[3], John J. Foxe[1,2,3]; [1]City College of New York, [2]Albert Einstein School of Medicine, [3]The Graduate Center of the City University of New York — Information from multiple sensory modalities can serve to enhance discrimination and detection in relation to its unisensory counterparts (e.g. Molholm, 2002). Behavioral studies have established that the manner in which multisensory inputs are treated and integrated develops over infancy and childhood (e.g. Barutchu, 2009; Lewkowicz, 1998; Gori, 2008); however, there are few studies that consider the developmental changes in related brain activity. In a preliminary investigation, we probe the neurophysiology of the integration of simple stimuli in a passive paradigm. Specifically, we used high-density electrophysiology to chart the developmental trajectory of auditory-somatosensory integration in children and adolescents. 45 children between the ages of 6 and 17 years completed a passive paradigm in which they watched a silent movie while holding a vibrotactile device and listened to sounds. Sounds and vibrations could occur alone (unisensory conditions) or together (AS condition). MSI was defined as significant deviation in the electrophysiological signal between the sum of the unisensory responses and the AS condition. Children were divided into 3 groups: 6-10 years (N = 15), 11-13 years (N = 14) and 14 -17 years (N = 14). Results indicated that two time periods of MSI, a first around 120 ms and a second around 300ms emerged and were common to the three age groups. However, MSI appeared more diffusely distributed in younger children and more organized and focal in the older groups. This may reflect a tuning of multisensory integration processes over the course of development.

C93

WITHIN-AND CROSS-MODAL MODULATION OF THE AUDITORY BRAINSTEM RESPONSE W. David Hairston[1], Tomasz Letowski[1], Kaleb McDowell[1]; [1]US Army Research Lab — Interactions between sensory modalities have been described across both cortical and sub-cortical levels, with some studies showing visual influence even in brainstem level auditory structures (1). Recent evidence for enhanced auditory brainstem response when paired with concurrent visual stimulation is particularly intriguing, especially considering work suggesting attention-related mediation of the frequency-following response (FFR) component (2), pointing to cortical top-down influence on fairly low levels of auditory processing. Here, we examine potential modulation of the FFR to background, non-task-relevant tones in light of which sensory modality (auditory, visual, no task) controls the task at hand. Subjects (N=18) perform fairly difficult visual and auditory duration-discrimination tasks within separate blocks. Stimuli are adjusted according to each subject's perceptual threshold to ensure equivalent difficulty and sufficient attention to the target modality. Background non-task relevant tones (220Hz) are used to elicit the brainstem FFR, with occasional oddball stimuli (259Hz) providing a cortical mismatch-negativity response. Fourier power for the principle background (220Hz) frequency is compared for each modality, in addition to resting (no-task) baseline. While results show little modulation in 220Hz power when performing visual tasks relative to a no-task baseline, there was a significant decrease in power observed when subjects focused on an auditory task instead. This suggests frequency-specific intra-modal inhibition, without cross-modal suppression in FFR during sustained task performance as might be expected. (1) Musacchia, Sams et al. (2006) Exp Brain Res 168(1-2): 1-10. (2) Galbraith, Olfman et al. (2003). Neuroreport 14(5): 735-8.

C94

NEURAL INTEGRATION OF AUDIO-VISUAL ENVIRONMENTAL EVENTS Jean Vettel[1], Adrian Nestor[2], Chris Bird[3], Laurie Heller[2], Tim Curran[3], Michael Tarr[2]; [1]Army Research Laboratory, [2]Carnegie Mellon University, [3]University of Colorado — Prior behavioral and neural research on multimodal integration has identified the critical role of spatial, temporal, and semantic congruency between modalities as factors guiding the integration between modalities (Meredith & Stein, 1993; Doehrmann & Naumer, 2008). We generated a novel stimulus set of audio-visual movies of environmental events, such as tapping a pencil or cutting paper. These movies allowed us to manipulate congruency between the temporal structure of the auditory and visual signals independently from the semantic labeling of the same auditory and visual signals. The first study, employing functional neuroimaging (fMRI), identified separable networks of regions for each of the integration cues, including a preference in the right hemisphere for time and a preference in the left hemisphere for semantics. The second study, employing EEG, complemented the fMRI findings by finding that each of the integration cues influenced the integration process at different time windows. The effects of temporal synchrony preceded the effects of semantic congruency. Together, these two studies effectively isolated the separable effects of both signal-based (time) and high-level (semantic) integration cues, finding that these two cues rely on functionally specialized neural substrates as well as different timescales during the process of multimodal integration. By identifying the separable components of the multimodal processing network, our study advances the understanding of how modality-specific information is bound into coherent event percepts.

C95

EVALUATING THE ROLE OF AWARENESS AND RECOGNITION IN SYNAESTHESIA: EVIDENCE FROM A PITCH- AND GRAPHEME-COLOR SYNAESTHETE Shujen Kung[1,2], Rocco Y. C. Chiou[1,3], Ovid J-L. Tzeng[1,4], Daisy L. Hung[1,3], Denise H. Wu[1,3]; [1]Laboratories for Cognitive Neuroscience, National Yang-Ming University, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taiwan, [3]Institute of Cognitive Neuroscience, National Central University, Taiwan, [4]Institute of Linguistics, Academia Sinica, Taiwan — Synaesthesia is an unusual condition in which one sensory event elicits sensations in multiple modalities. There is an ongoing debate concerning the prerequisite of synaesthesia. Some researchers contend that being aware of the inducer is critical while others emphasize the role of recognition of the inducer's meaning. In this study we report an amateur musician with absolute pitch, TD, who experiences color in association with letters, pitches, and musical keys. Interestingly, TD's color sensation elicited by a pitch was not dependent on the pitch itself but on TD's subjective identification of the pitch. In a priming task, TD's color naming performance was facilitated by both letters and symbols of musical keys when the inducer could be clearly perceived but not when the inducer was quickly masked. Moreover, the priming effect resulting from an inducing letter was greater than that from an inducing musical key, presumably because the former is easier to recognize than the latter. Consistent results were also obtained from a Stroop naming task. On the one hand, TD's color naming performance was influenced by the synaesthetic color elicited by letters but not the color elicited by symbols of musical keys. On the other hand, the synaesthetic congruency effect was larger for musical symbols than for letters when TD was required to name the identity of the inducer of synaesthetic experience. The findings from the current study indicate that although awareness of the inducer is necessary for synaesthetic experience, recognition of the inducer's meaning determines the synaesthetic sensation.

C96

ANALGESIC EFFECTS OF ILLUSORY SELF-PERCEPTION Bigna Lenggenhager[1], Alexander Hänsel[2], Roland von Känel[2], Michele Curatolo[2], Olaf Blanke[1,3]; [1]Ecole Polytechnique Fédérale de Lausanne, Switzerland, [2]University Hospital of Bern, Inselspital, Switzerland, [3]University Hospital of Geneva, Switzerland — Pain is a classical example of a first-person experience that necessarily requires a subject of conscious experience, thus a "self". Basic foundations of the self lie in brain mechanisms representing the body (Blanke & Metzinger 2009). Thus, recent studies showed that aspects of the self can be manipulated by exposing healthy participants to conflicting multisensory input about their body (e.g. Ehrsson 2007). We here investigated whether such alterations of the bodily self may modulate pain perception. Participants saw through a head-mounted display two meters in front of them either a body (from the back) or an object being stroked either synchronously or asynchronously with their own back. Synchronous stroking of the body has previously shown to lead to changes in basic aspects of the self such as self-identification and self-location (Lenggenhager et al. 2007). Here, we measured pressure-induced pain thresholds at the participant's finger during the four conditions. Our results show that the pain threshold was highest and significantly differed from baseline ($t=2.7$; $p=0.02$) during synchronous stroking of the body where the participants also self-identified (measured by questionnaire) strongest with the shown object. Furthermore the data show in this condition a significant correlation between the pain threshold and the self-identification score ($r=0.55$; $p=0.03$). The data suggest that alteration of self through conflicting multisensory bodily input can increase pain-thresholds significantly. This confirms the idea that the conscious sense of our bodily self and physiological regulation are closely linked. We believe these findings might be useful to develop novel behavioral pain therapies.

C97

NEURAL CORRELATES OF PERSON IDENTITY REPRESENTATION EMERGING FROM FACES AND VOICES Shahin Zangenehpour[1,2], Martha Shiell[2], Pascal Belin[3], Robert Zatorre[2,4]; [1]McGill University, [2]Montréal Neurological Institute, McGill University, [3]Centre for Cognitive Neuroimaging, University of Glasgow, [4]BRAMS Laboratory — Faces and voices are normally experienced simultaneously, and convey important information about speech, affective content and person identity. Little is known about how person identity is represented as a result of binding of faces and voices. We designed behavioural and neuroimaging experiments to study this phenomenon systematically. Thirteen healthy adults (8 females), aged 20-29 years, participated. The experiment involved two training sessions and one fMRI session, that were 1-3 days apart. The stimuli consisted of short video clips of unfamiliar faces saying single numbers which matched or mismatched across trials. We implemented two tasks: In the content task, participants indicated if the face and voice were saying the same number. The purpose of the content task was to allow participants to implicitly associate face-voice pairs with specific individual identities during training. In the identity task, participants indicated whether or not a given face-voice pair belonged to the same person, based on the pairs learned during the content task. Participants performed both tasks during each training session and during scanning, and the identity task was repeated after scanning to measure degree of retention. Accuracy on the identity task improved over the two training sessions, and remained consistent during and after scanning. Preliminary imaging results suggest group-level hemodynamic responses associated with the identity task in anterior portions of superior temporal sulcus (bilateral) and the right putamen. We discuss these findings in the context of a global model of face-voice interaction for the processing of speech, affective and identity information.

C98

FEELING OF WEIGHT: PERCEPTION OF WEIGHT IN THE SOMATOSENSORY CORTEX Nikola Valchev[1,2], Emmanuele Tidoni[3], Antonia Hamilton[4], Valeria Gazzola[1,2], Alessio Avenanti[5,6]; [1]BCN Neuroimaging Center, University of Groningen, The Netherlands, [2]Netherlands Institute for Neuroscience, Royal Netherlands Academy of Arts and Sciences, Amsterdam, The Netherlands, [3]University of Rome La Sapienza, Rome, Italy, [4]School of Psychology, University of Nottingham, Nottingham, UK, [5]University of Bologna, Bologna, Italy, [6]Centre for studies and researches in Cognitive Neuroscience (CsrNC), Cesena, Italy — Most of us might have experienced, while seeing backpackers hiking, the weight of their backpacks on our shoulders and our legs becoming heavier. A network of, parietal and premotor cortices, active both during action execution and observation (mirror neuron system), suggests that we understand the actions of other people by simulating what we would do in the same circumstances (Rizzolatti and Craighero, 2004). Although neurophysiological studies show an involvement of somatosensory cortices (S1) during action observation and execution (Avikanen et al., 2002; Raos et al., 2004; Gazzola, Keysers, 2008), it is not clear whether activity in S1 plays a crucial role in understanding the observed action. To test the role of S1 in action perception we used off-line continuous theta-burst stimulation (cTBS) by means of transcranial magnetic stimulation in a weight judgement task (Pobric, Hamilton, 2006). Participants observed an actor lifting a box and judged the box weight. In counterbalanced sessions, we delivered sham- and real-rTMS over the hand region of S1 and M1. Real-cTBS over S1, but not over M1, impaired the task performance relative to sham conditions. Moreover, cTBS over S1 delivered just before the participants were asked to evaluate the weight of a bouncing ball did not alter performance. These findings indicate that S1 plays a causal role in extracting somatosensory features (heavy/light) from observed action kinematics. We can therefore understand the backpackers' hiking through motor simulation, but we can only feel the weight of his backpack through S1, supporting the existence of a sensori-motor simulation.

C99

NEURAL BASIS OF EMOTIONAL MODULATION OF SIMULATED DRIVING PERFORMANCE: AN FMRI MULTITASKING STUDY Li Hsieh[1], Sean Seaman[1], Quan Jiang[2], Susan Bowyer[2], John Moran[2], Richard Young[3]; [1]Wayne State University, [2]Henry Ford Hospital, [3]School of Medicine, Wayne State University — This fMRI study investigated the role of emotion in multitasking using a multi-modal task designed to assess the effect of emotional speech on visual event detection during simulated driving. Ten participants were asked to respond to visual stimuli in a go/no go design while covertly answering spoken questions. Behavioral results showed longer visual reaction times during a concurrent speech task than with no speech; however this effect was moderated by presenting speech questions in an angry voice. fMRI analysis indicated increased activations ($t > 3.2$; $p < 0.0014$) associated with both neutral and angry speech tasks, compared to no speech, in the bilateral temporal lobes, the left inferior frontal gyrus, and the left middle frontal gyrus; and decreased activations in the right inferior parietal lobe and the right cuneus. Direct comparisons between angry and neutral speech tasks showed increased activations ($t > 2.8$; $p < 0.0051$) in the right prefrontal gyrus, the right middle frontal gyrus (BA10), the right insular, the right superior temporal gyrus, the right paracentral lobule (BA5), the right claustrum, and the right inferior parietal lobe (BA40). Decreased activations were found in the left frontal operculum, the left lingual gyrus (BA18), and the left parahippocamal gyrus (BA28). These results suggest that speech compared to no speech causes slightly longer behavioral reaction times and increased brain activation in language areas. Moreover, an angry emotional tone improves behavioral reaction time performance compared to a neutral tone, while eliciting the right frontoparietal networks and dampening the left frontal activity.

C100

THE TIMING OF ACTIVATION IN SYNESTHESIA: A MAGNETOENCEPHALOGRAPHY STUDY David Brang[1], Edward M. Hubbard[2], Seana Coulson[1], Mingxiong Huang[1], Vilayanur S. Ramachandran[1]; [1]University of CA, San Diego, [2]Vanderbilt University — Grapheme-color synesthesia is a neurological phenomenon in which particular letters and numbers (graphemes) consistently evoke particular colors (e.g. A=red). The neural basis of synesthesia has been thoroughly explored, but a debate lingers into the underlying mechanisms. The cross-activation theory proposes that the experience of colored letters arises as a result of cross-activation between grapheme areas in the fusiform gyrus and neighboring color area V4. In contrast, the disinhibited feedback theory proposes a disinhibition of pre-existing, 'latent' feedback connections among areas in the hierarchy of visual processing; the two models thus make different predictions about the time course of neural activity in color area V4 (early vs. late). In order to resolve this debate, we used magnetoencephalography (MEG) to test whether V4 and grapheme regions activate nearly simultaneously, as predicted by the cross-activation theory, or whether V4 activation occurs only after the initial stages of grapheme processing, as predicted by the disinhibited feedback theory. Here we show that differences in V4 activation between synesthetes and non-synesthetic controls arise between 140 and 160ms, immediately after the earliest stages of letter and number processing. The excellent spatial and temporal resolution provided by MEG complements earlier neuroimaging studies of synesthesia using methods with poor temporal resolution (fMRI), and those with less precise spatial resolution (EEG). Overall, these data argues against the disinhibited feedback theory of synesthesia, suggest that the perception of synesthetically colored letters involves cross-activation of V4 and grapheme areas, and that the conscious perception of graphemes in all individuals arises after 130ms.

C101

BACKWARD PRIMING OF BISTABLE ILLUSIONS AND AUDITORY CONDITIONING OF MOTION PERCEPTION: TWO NOVEL PRIMING EFFECTS V. S. Ramachandran[1], Laura K. Case[1]; [1]University of California, San Diego — While forward priming of visual images is well documented, backward priming, in which a prime temporally follows the target, has been reported only for lexical tasks. Similarly, auditory cues can prime perception, but conditioning has not been reported based on arbitrary sound-motion pairings. Here we report two new priming effects: backward-priming of bistable visual illusions, and auditory conditioning of ambiguous motion. In Study 1, participants in the priming group saw a bistable visual illusion (target) followed temporally by a prime, an unambiguated version of the image. The control group saw only the target image. When a backward prime is congruent with the less frequently perceived version of the target, significant backward-priming is achieved. When the prime is the more frequently perceived version, however, perception is not affected, possibly due to a ceiling effect. This demonstrates, for the first time, a backward priming effect for bistable visual illusions. In study 2 participants underwent a training period in which unambiguated left or right rotation of the popular spinning dancer illusion was paired with a high or low tone. After three minutes of distraction, we presented the ambiguous spinning dancer with a tone (priming group) or without a tone (control) and compared rates of perception of left or right rotation. We also tested the effect of explicitly trying to see left or right rotation and found significant but independent effects of volition and tone on motion perception. This suggests that motion perception can be influenced both through cross-modal conditioning and by volition.

C102

AUDITORY-VISUAL INTERACTIONS AND RHYTHMIC STRUCTURE Victoria Cheah[1], Fruzsina Soltesz[1], Denes Szucs[1], Usha Goswami[1]; [1]University of Cambridge, Centre for Neuroscience in Education — Meaningful sounds in the natural world such as language and music have a rhythmic structure. However, the neural mechanisms underlying the detection of rhythmicity, and its effects on perception are unclear. It has been suggested that neuronal assemblies in the brain entrain their pattern of excitability to temporally-structured stimuli in the environment (Schroeder & Lakatos, 2009). Previous studies also indicate that the phase of ongoing neural oscillatory activity affects behavioural reaction times (Lakatos et al, 2008; Senkowski et al, 2006). This suggests a potential role for temporal rhythmicity in constraining perception and action via the mechanism of neuronal oscillatory entrainment. In this study, we characterized the effect of rhythmic (auditory) entrainment on performance in an active visual flash detection task. We find that participants' behavioural reaction time profile shows key differences in slope and periodicity when the task is performed with and without a rhythmic context. These differences are compatible with previous findings of the effects of neuronal oscillatory activity on reaction time. We conclude that the presence of a strong rhythmic context produces characteristic effects on performance, even when the rhythmic stimuli (tones) are irrelevant to the main task (visual flash detection). These effects are mainly facilitatory in nature (they decrease reaction time), and show a temporal dependency on the entraining rhythmic period. These results support the hypothesis that temporal rhythmicity may constrain perception and action by enhancing readiness or expectancy during certain 'phases' of the rhythmic interval.

C103

TEMPORO-PARIETAL CORTEX ENCODES LOCATION OF THE SELF: JOINING FMRI WITH NEUROSCIENCE ROBOTICS TO STUDY BODILY SELF-CONSCIOUSNESS Silvio Ionta[1], Bigna Lenggenhager[1], Michael Mouthon[1], Dominique Chapuis[2], Roger Gassert[2], Olaf Blanke[1,3]; [1]Laboratory of Cognitive Neuroscience, Brain Mind Institute, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [2]Swiss Federal Institute of Technology Zurich (ETH), Zurich, Switzerland, [3]University Hospital (HUG), Geneva, Switzerland — Neuroscience of the self has focused on high-level mechanisms related to language, memory or imagery of the self and implicated a widely distributed brain network. Yet recent evidence suggests that low-level mechanisms such as multisensory and sensorimotor integration may play a fundamental role in self-related processing (Blanke and Metzinger, 2009). In the present study we used visuo-tactile multisensory conflict, techniques from robotics and virtual reality to study such low-level mechanisms by experimentally inducing changes in self-location (Lenggenhager et al., 2009) during fMRI recording. Subjects saw a video of a person's back (Body) or an empty room (No Body) being stroked while a MR-compatible robotic device stroked their back (tactile input) matching (synchronous) or not (asynchronous) the direction and speed of the seen stroking. Self-location was estimated using the mental ball dropping (Lenggenhager et al., (2009) and confirmed these previous behavioral results by showing that self-location only differed between the two Body conditions. fMRI results showed the bilateral activation of the temporo-parietal cortex with a significantly higher BOLD signal increase in the Synchronous/Body condition with respect to the other conditions (Synchrony x Object interaction). Sensorimotor and supplementary motor areas were also active. The temporo-parietal activity reflects illusory disembodiment as induced experimentally. These data are compatible with clinical data in neurological patients with out-of-body experiences (Blanke et al., 2004; deRidder et al., 2007). We discuss that the experience of the conscious "I" as embodied and localized within bodily space is reflected by an activation of these components of the default network.

C104

MULTIMODAL PERCEPTION OF WHISPERED AND VOICED PROSODY IN FRENCH: A PRELIMINARY FMRI STUDY Marion Dohen[1], Hélène Loevenbruck[1], Akiko Callan[2], Daniel Callan[3,4], Monica Baciu[5], Cédric Pichat[5], Harold Hill[2,6]; [1]GIPSA Laboratories, [2]Cognitive Information Science Laboratories, ATR, [3]National Institute of Information and Communication

Technology, Kyoto, [4]Computational Neuroscience Laboratories, ATR, [5]Laboratoire de Psychologie et Neurocognition, [6]School of Psychology, University of Wollongong — After long being considered to be right-lateralized, the processing of prosody appears to be bilateral. Moreover, prosody is traditionally considered as an auditory process, but we have shown that it is multisensory (Dohen & Lœvenbruck, 2009). This fMRI study examines the processing of prosodic contrastive focus (emphasizing a constituent in an utterance). Previous studies (Wildgruber et al. 2004, Tong et al. 2005) have shown the involvement of bilateral or left-only temporal and parietal regions and bilateral or right-only frontal regions. In this study, 12 subjects were asked to judge whether part of an utterance was focused or not. The stimuli were presented in 3 modalities: auditorily, audiovisually or visually and in normal (voiced) speech or whispered speech. The event-related pseudo-random design included 4 functional scans (half voiced, half whisper). Each scan included 12 events per condition (6 conditions: 3 modalities x 2 prosodic cases) and 14 null-events. The behavioural results show that subjects were able to identify focus from non-focus cases. The processing of focus vs. baseline in voiced speech yields bilateral auditory activations in BA22, 41-42, and left temporal gyrus, inferior frontal gyrus, supplementary motor area and cingulate gyrus. Whispered speech additionally activates the right BA6. Furthermore, for both voiced and whispered speech, identifying focus vs. non-focus involves the left supramarginal gyrus and the left inferior temporal gyrus (BA37). Perception of prosodic focus (vs. no focus) appears to be essentially processed in left associative areas. This illustrates the necessity of associating various types of information to detect focus.

C105

MODULATION OF THERMAL PAIN FROM MAGNIFIED AND MINIMIZED VISUAL FEEDBACK Luke Miller[1], David Brang[1], Vilayanur S. Ramachandran[1]; [1]Center for Brain and Cognition, University of California San Diego — Research has shown that visual capture can reduce the noxious experience of pain in select patient populations, including those with phantom limbs, reflex sympathetic dystrophy, and chronic hand pain. While this finding has profound implications for the novel treatment of pain, research to date has only examined instances of long-term pain. To see the effects of visual capture on the modulation of acute pain, we tested the tolerable threshold to temperature-induced pain in 10 neurotypical individuals using copper bars heated to 50.0 degrees Celsius. Three different lenses were used: a neutral lens, a magnifying lens which increased perceived limb size twice that of normal vision, and a minifying lens, which decreased perceived limb size twice that of normal vision. Subjects were asked to hold one finger at a time on one of the copper bars for as long as the pain was tolerable and reaction time in milliseconds was measured. This was done twenty four times for each of the three lenses, which were presented in randomized order. Results showed that the magnifying lens significantly decreased the amount of pain subjects were able to tolerate compared to both the minifying and normal lens. However, there was no significant difference in reaction time between the minifying lens and the neutral lens. While this contradicts previous data found in patients experiencing chronic pain, results from the magnifying lens condition have profound implications for the neural mechanisms of pain, and its integration with visual capture.

C106

ORDINAL SEQUENCES AND SPACE: CONSISTENCY OF MAPPINGS OVER TIME Laura Gibson[1], Daphne Maurer[1]; [1]McMaster University — A majority of both synaesthetes and non-synaesthetes perceive ordinal sequences on a mental "number" line that is oriented from the left to the right side of space (Dehaene et al., 1993; Sagiv et al., 2006). Although the consistency of ordinal-space associations over time in synaesthetes is well-established, the reliability of these ordinal-space mappings in non-synaesthetes has not been investigated. We studied the stability of ordinal-space associations for numbers, days of the week, and months of the year in non-synaesthetes (n=60), who were tested on two separate occasions 1-3 weeks apart. Participants decided whether a presented number was greater or less than 5 by pushing buttons with the congruent (e.g. left hand for low digits) or incongruent hand (e.g. left hand for high digits). We designed similar tasks for weekdays and months. Participants exhibited a significant SNARC effect for numbers and days on both visits, and a significant SNARC effect for months on visit two. Pearson r correlations indicated that the size of the SNARC effect was modestly consistent across the two visits for numbers and months (both rs > 0.3), with a similar trend for days of the week (r=0.26). The consistency of non-synaesthetes over time supports the hypothesis that synaesthetes and non-synaesthetes may share a common underlying neural architecture linking ordinal sequences and space.

C107

LATERAL OCCIPITAL COMPLEX: A SITE FOR SUPRAMODAL SHAPE REPRESENTATION AS REVEALED BY SENSORY SUBSTITUTION LEARNING Jung-Kyong Kim[1,2,3], Robert J. Zatorre[1,2,3]; [1]Montréal Neurological Institute, [2]McGill University, [3]BRAMS Laboratory — Part of the lateral occipital complex (LOC) is known to be engaged in processing of shape recognized by vision and touch, the sensory modalities where shape is an inherent property. Given the bi-modal nature of this region, a question can be asked how robust the LOC activity is to different sensory modalities. We addressed this question by examining brain activity involved in processing of tactile shape that is artificially coded in sound (by using the image-to-sound conversion algorithm called the vOICe). Nine blindfolded sighted subjects participated in five sessions during which they learned the tactile-auditory relationship between raised abstract shapes and their corresponding shape-coded sounds. Using functional magnetic resonance imaging, subjects were scanned before and after training during the task where they first listened to a shape-coded sound-transformation, touched a raised figure, then responded whether or not the stimuli matched in shape. The post-training session involved an additional condition where the tactile part of the task was replaced by vision. We found that behavioral scores improved after training, and that LOC was commonly activated during the auditory and tactile conditions before and after training, with a trend for increase in the post-training activity. Subjects showed complete transfer of learning on the matching task where shape was presented auditorily and then visually . These results suggest that shape can be represented at an abstract level that transcends the sensory modalities from which it is originally accessed, and that LOC is a supramodal region where shape information from different modalities converges.

C108

HEARING FACIAL IDENTITIES: BRAIN CORRELATES OF FACE-VOICE INTEGRATION IN PERSON RECOGNITION Stefan Schweinberger[1,2], David Robertson[1], Nadine Kloth[1,2]; [1]DFG Person Perception Research Unit, Friedrich Schiller University of Jena, Germany, [2]Friedrich Schiller University of Jena, Germany — Audiovisual integration is well-known in speech perception. However, the integration of facial and vocal information is also important for speaker recognition. We recently demonstrated audiovisual integration in the recognition of familiar speakers (Schweinberger, Robertson, & Kaufmann, 2007, QJEP; Robertson & Schweinberger, 2009, QJEP). Specifically, we observed systematic behavioral benefits and costs for the recognition of familiar voices when these were combined with time-synchronized articulating faces of corresponding or noncorresponding speaker identity, respectively. These effects are strong for familiar voices but weak or absent for unfamiliar voices, suggesting that the effects depend on the previous creation of a multimodal representation of a person's identity. For the first time, the present study investigated event-related brain potentials (ERPs) in this novel paradigm, while participants recognized familiar speakers which were presented in (1) voice only, (2) voice with corresponding, or (3) non-corresponding time-synchronized visual speakers, or (4) visual speaker only conditions. Speaker identity correspondence influenced later ERPs from 250 ms only. Of particular interest, when compared with the summed ERPs from both unimodal conditions, both audiovisual conditions led to a much earlier onset of fronto-central negativity, with maximal differences around 50-80 ms. This suggests that the perception of a time-synchronized face and a voice triggers a surprisingly early and mandatory mechanism of audiovisual integration, although the correspondence or discrepancy in auditory vs. visual speaker identity may only be computed ~200 ms later.

C109

CATEGORY-SPECIFIC DIFFERENCES IN MULTISENSORY INTEGRATION: AN ERP INVESTIGATION OF SEMANTIC CONGRUENCY EFFECTS FOR LIVING AND NONLIVING ITEMS Elena K. Festa[1], William C. Heindel[1]; [1]Brown University — This study investigated the degree to which category membership of objects (living vs. nonliving) influences the binding of audiovisual sensory features into meaningful, multimodal object representations. Subjects were shown pictures of objects that were either upright or inverted, and asked to identify the orientation of the object by pressing one of two response buttons. A sound that was either semantically congruent or incongruent to the object was presented with each picture. Half the pictures were of living objects (e.g., horse) and half nonliving objects (e.g., telephone). Within each category object set, half the pictures were shown in the upright orientation and half in the inverted orientation. For upright pictures, participants identified the objects faster when they were paired with semantically congruent rather than incongruent sounds, regardless of category membership. For inverted pictures, response times were slower and did not differ across congruency conditions for either category. For living objects, semantic congruency modulated the amplitude of the P2 ERP component for both upright and inverted pictures, and additionally modulated the N4 component for upright but not inverted pictures. For nonliving objects, semantic congruency failed to modulate the P2 or N4 component regardless of orientation, but rather elicited a late frontal negativity for upright but not inverted pictures. Taken together, these results suggest living items are processed and bound automatically on the basis of audiovisual sensory feature representations within semantic memory, whereas the binding of audiovisual features of nonliving items is dependent on the controlled processing of semantic context.

C110

TIME REFERENCE IN TURKISH AGRAMMATISM Elif Bamyaci[1], Roelien Bastiaanse[2]; [1]European Master's in Clinical Linguistics (EMCL), [2]Center for Language and Cognition Groningen (CLCG) — Time reference in Turkish agrammatic speakers Elif Bamyaci (EMCL) & Roelien Bastiaanse (CLCG) Introduction In Agrammatic speech verb inflections seem to be particularly vulnerable, although not each verb inflection morpheme is impaired to an equal extent. It has been shown that Tense features are particularly prone to errors (Friedmann&Grodzinsky,1997). Within the Tense domain reference to the past seems to be more impaired than reference to the present (Bastiaanse, 2008; Stavrakaki&Kouvava,2003; Simonsen&Lind,2002) and future (Yarbay Duman&Bastiaanse,2009). Interestingly, Turkish has two forms of past Tense, 'seen past' and 'heard past'. The aims of this study are two-fold: to evaluate whether in Turkish, with the rich verb inflection paradigm present Tense is better preserved than past Tense; to see whether there is a difference between heard and seen past Tense. Methods 7 agrammatic and 7 non-brain-damaged speakers were tested through a 'sentence completion with prompting' paradigm with three conditions. Results According to Fisher's exact tests Present Tense is significantly better than both past Tenses (p=0.0001). Seen past tense is more difficult than heard past Tense (p=0.0012). Discussion In contrast to present Tense, establishing the truth value of a past event is not self-evident, which might make verb inflection for the past more difficult. 'Heard past' needs to be checked with someone else's or general knowledge that is usually taken for granted. However, in 'seen past' the speaker has to think about the truth value and check it against his memory. This personal involvement makes coding for such an event more difficult.

C111

SENSORY REFERRAL IN TEMPORARILY ANESTHETIZED ARMS: THE MIRROR NEURON DISINHIBITION HYPOTHESIS Laura K. Case[1], V. S. Ramachandran[1]; [1]University of California, San Diego — If the mirror neuron system maps other people's sensory and motor activity onto our own sensory and motor cortices, why do we not feel it in our own body? One idea is that our own sensory and motor activity inhibits conscious perception of mirror neuron activity. This generates the hypothesis that an amputee, lacking sensory and motor activity in one arm, should directly and consciously experience tactile sensations in his phantom while observing touch to another person's arm. Ramachandran & Brang recently reported this (2009). However, does disinhibition immediately follow amputation, or is longer term rewiring of sensory cortex necessary? Referred sensation from the face to the phantom arm has also been observed after amputation; is cortical rewiring the cause, or rapid disinhibition of neighboring cortical regions? We systematically examined five orthopedic surgery patients with brachial plexus blocks approximately 30 minutes post-surgery. Three of five patients reported sensory referral from a model to the blocked arm, intermanual referral from the intact arm to the blocked arm, and referral from the ipsilateral face to the blocked arm. These observations support the disinhibition hypothesis that mirror neuron activity is normally suppressed from conscious representation by input from ones own body, but incorporated into ones body representation in its absence. Intriguingly there was some referral to the intact arm as predicted from transcallosal effects in animals. The result is a radical new view of the brain: fluctuating mosaics in a perpetual state of dynamic equilibrium with each other and indeed with other brains.

C112

INTERACTIONS BETWEEN HANDEDNESS AND OBJECT ORIENTATION ON MANIPULATION JUDGMENTS INVOLVING COMMON TOOLS Evangelia G. Chrysikou[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania — Neuroimaging and neuropsychological evidence supports theories of embodied cognition that highlight the relations between sensorimotor and cognitive systems, particularly in tasks involving everyday objects. Successful object use requires knowledge retrieval that incorporates information about the object's function and potential for action. Previous research has shown that factors such as an object's size, the degree of rotation from an object's canonical position, or the participant's viewpoint influence object recognition. Few studies, however, have examined object knowledge in left-handed participants. In this experiment we examined whether the orientation of an object (right/left) interacts with participants' sensorimotor experience as indicated by the type (right/left) and degree (strong/weak) of their handedness. Thirty-three participants (15 left-handed) were presented with pictures of graspable everyday items that were oriented either for a right- or left-handed grasp. They were asked to identify the type of grasp they would employ (i.e., clench or pinch) when using each object for its typical function. The analysis of voice-onset reaction times showed a significant interaction between handedness and object orientation, such that right-handed participants were faster to decide on the type of grasp they would use when the objects were oriented to the right, whereas left-handed participants were faster to make such decisions when the objects were oriented to the left. We discuss these findings in the context of the results of two earlier experiments in which interactions between handedness and object orientation were absent when participants were simply asked to either name the objects or identify the objects' canonical function.

C113

MULTISENSORY INTERACTIONS FACILITATE CATEGORICAL DISCRIMINATION OF OBJECTS Celine Cappe[1], Micah Murray[1,2,3]; [1]Radiology & Neuropsychology, CHUV and University Lausanne, Switzerland, [2]Electroencephalography Brain Mapping Core, Center for Biomedical Imaging of Lausanne and Geneva, Switzerland, [3]Sciences, Vanderbilt University Medical Center, Nashville, TN — This study investigated the extent to which the discrimination of objects is affected under multisensory conditions. Research investigating integration of synchronously presented auditory-visual objects has focused on effects of attention and/or has limited the stimulus set. It thus remains unknown whether categorical discrimination of environmental objects, and object recognition generally, benefits from multisensory stimulation either at a behavioral or neurophysiologic level. We focused here on the categories of living and non-living objects given previous research demonstrating these to engage (partially) dissociable brain networks. Participants were presented with auditory, visual, or simultaneous auditory-visual stimuli during a living/non-living discrimination task. Reaction times (RTs) were slower for auditory than other conditions, but there was no evidence that RTs differed between visual and multisensory conditions. There was no difference between RTs for either category. Thus, there was no support for multisensory facilitation of behavior, perhaps due to visual stimuli being highly effective. Nevertheless, our ongoing electrical neuroimaging analyses revealed facilitation of discrimination of object categories with multisensory versus either unisensory condition. Both auditory and visual conditions exhibited topographic differences between living and non-living object at ~140ms, indicative of configuration changes in the intracranial sources active in response to these object categories when presented visually or acoustically. However, following multisensory stimulation, this differential effect occurred ~20ms earlier. While not necessarily facilitating the earliest stages of categorical discrimination, these results nonetheless suggest that object recognition processes in vision and audition interact and can facilitate one another under multisensory conditions.

C114

WHEN WHAT WE HEAR IMPACTS WHAT WE FEEL: AUDITORY INPUT MODULATES NEURAL ACTIVITY IN PRIMARY SOMATOSENSORY CORTEX Gabriella Musacchia[1], Peter Lakatos[1,2], Aimee Mills[1], O'Connell Monica[1], Schroeder Charles[1,3]; [1]Nathan S. Kline Institute for Psychiatric Research, [2]New York University School of Medicine, [3]Columbia University — Several lines of research have shown that both visual and somatosensory input can greatly impact the neural encoding of sound; even in primary auditory areas. However, less is known about the converse: e.g. how visual or somatosensory encoding is affected by auditory input. The current study examines effects of auditory input on laminar profiles of neural activity in primary somatosensory cortex using linear array multielectrodes positioned so as to record from all cortical layers concurrently. Our main findings are, first, that auditory stimuli elicit a modulatory pattern of neural response in somatosensory cortex such that ongoing neural oscillations in the superficial layers of area 3B are reset. Second, we find that spatially-matching and non-matching bimodal stimuli have opposing effects on the amplitude of the somatosensory response. And finally, our data show that bimodal enhancement of neural activity in primary somatosensory cortex is greatest for low (near threshold) and middle intensity levels of tactile stimulation. These findings parallel the input patterns and principles of multisensory interaction in auditory cortex. Specifically, somatosensory and bimodal stimuli elicit evoked neural responses and reset neural oscillations in primary somatosensory cortex, while auditory stimuli induce a mainly modulatory phase concentration effect with little evoked activity. Together with earlier studies, the current study suggests that multisensory mechanisms operate through similar mechanisms and according to analogous principles across primary sensory cortices.

C115

MAKING SENSE OF SCENTS: THE COLOUR AND TEXTURE OF ODOURS Ferrinne Spector[1,2], Daphne Maurer[1]; [1]McMaster University, [2]University of Wisconsin, Madison — The purpose of this study was to document colour and texture associations to odours using a variety of odours including some likely to be unfamiliar, and both pleasant and unpleasant odours. We asked non-synaesthetic adults (n = 78) to make colour and shape/texture associations to 22 odours. A subset of the participants (n = 41) smelled the odours a second time in order to identify them. Each odour stimulus was associated consistently to one or more specific colours and/or textures (all ps < .01 by binomial probability statistics). Associations to the four odours that were identified accurately (cinnamon, lemon, peppermint and licorice) seemed to be based on learning/memory (e.g., lemon = yellow). The associations to the 18 odours that were not identified accurately are less likely to be based on learning/memory (e.g., ginger = black, rough, sharp; lavender = green, white, liquid, sticky). The results suggest that sensory associations to odours, like those to pitch and letters (e.g., Mondloch & Maurer, 2004; Spector & Maurer, 2008), may result from the joint influence of learning and natural biases linking dimensions across sensory systems. Such links may reflect inherent neural organization that is modifiable with learning and that can manifest as cross-modal associations or synaesthetic percepts.

C116

SEVERE MULTISENSORY SPEECH INTEGRATION DEFICITS IN CHILDREN WITH AUTISM Daniella Blanco[1], Rebecca K. Reed[1], Lars A. Ross[2], Dave Saint-Amour[3], Sophie Molholm[1], John J. Foxe[1]; [1]The Childrens Research Unit (CRU), Program in Cognitive Neuroscience, City College of New York, New York, [2]The Cognitive Neuroscience Laboratory, Temple University, Philadelphia, Pennsylvania, [3]CHU Sainte-Justine Research Center, Université du Québec à Montréal, Quebec — Visualizing a speaker's articulations substantially improves the intelligibility of spoken speech and this is especially so when listening conditions are very noisy. This multisensory integration of speech inputs is crucial to effective communication, and appropriate development of this capacity will have major impact on a child's ability to successfully navigate educational and social settings. It has long been speculated that children with autism spectrum disorder (ASD) have particular deficits in multisensory integration abilities, and yet there is a surprising scarcity of hard empirical evidence to this effect. Here, we assessed the abilities of a cohort of high-functioning ASD children (N=15) to integrate seen and heard speech as environmental noise levels were systematically manipulated, comparing them to an age-matched typically developing (TD) cohort (N=15) and also to a group of adult observers. We uncovered a severe deficit in the ability of the ASD children to benefit from visual inputs relative to TD children, a deficit that became more and more severe as background noise levels were increased. In our view, these results have important implications for educators and clinicians working with ASD children. The severity of the deficit in multisensory integration for the ASD children makes it clear that special efforts should be made to ensure that the environment in classrooms and other rehabilitative settings, as well as in the home, be specifically controlled so that information can be effectively communicated. Interventional strategies that work to specifically promote the development of multisensory speech integration mechanisms are clearly called for.

C117

SENSORIMOTOR RHYTHM ON HEALTHY BABIES OF 4 AND 8 MONTH OLD Minerva Moguel-Gonzalez[1], Milene Roca-Stappung[1], Thalia Fernandez[1], Thalia Harmony[1]; [1]Instituto de Neurobiologia, UNAM Campus Juriquilla — Objective: To study sensoriomotor rhythm on healthy babies of 4 and 8 month old. Sensorimotor rhythm (SMR) has been described in babies between 6 and 8.8 Hz in central and frontal leads during an attentive and no movement condition. The main purpose of this study is to assess SMR during attentive and no movement condition and also characterize the contralateral desynchronization of SMR when movement is exclusively on the right or the left upper limb. EEG was recorded in F3, F4, C3, C4, Fz and Cz leads using as reference short-circuited ear lobes; four conditions were recorded – free movement, attentive and no movement, exclusive movement of the right upper limb and exclusive movement of the left upper limb-. SMR frequency range was taken between 6 and 8.8 Hz and a narrow band analysis of the absolute power was carried out to each test condition, geometric power was applied to each value. Preliminary results show that 4 month old babies have highest SMR absolute power values on frontal region in the band around 7 Hz while 8 month old babies present highest SMR absolute power values on frontal and central regions on the band around 8 Hz. Contralateral desynchronization on 4 month old babies is not conclusive but 8 month old babies show contralateral desynchronization of SMR on central leads in the band around 8 Hz. These results suggest that SMR frequency increases with age and SMR desynchronization could be a maturational EEG sign. Supported by CONACyT

C118

THE RECOGNITION OF ACTIVELY VS. PASSIVELY LEARNED AUDIOVISUAL ASSOCIATIONS Andrew J. Butler[1], Karin H. James[1]; [1]Indiana University, Bloomington — In everyday experience we often learn about objects actively, using physical exploration, through multiple senses. After these experiences we can recognize objects using both unisensory and multisensory associative information. Theoretical accounts and empirical evidence suggest that regions involved in perception and motor processes during encoding are reactivated during subsequent recognition. Active learning enhances later memory performance, and leads to the involvement of motor systems during recognition. Twenty participants were included in a study using fMRI that explored the neural correlates of two types of recognition under two different types of training. Half of the participants learned actively, using novel visual objects to make a novel associated sounds, and the other half passively viewed another perform this task. Unisensory old/new recognition tests, and multisensory associative recognition tasks were administered to these two groups during fMRI. There were four main results: A) Active learning significantly speeded both unisensory and multisensory associative recognition, and increased the accuracy of multisensory associative recognition. B) Evidence was found for crossmodal perceptual reactivation during the recognition of the unisensory aspects of the multisensory objects in both groups C) Activation of motor and premotor regions was specifically associated with the presentation of audiovisual associations after active learning. D) Active learning was specifically associated with the activation of a know site of audiovisual integration (Superior Temporal Sulcus) during the presentation of multisensory information relative to unisensory information. These results suggest that active learning enhances performance, and modulates the involvement of motor and multisensory systems during recognition.

C119

MULTISENSORY INTEGRATION IN SENSORY CORTICES: INTRACRANIAL EVIDENCE IN HUMANS Manuel Mercier[1,3], Sophie Molholm[1,2], Jonathan P. Dyke[3], Theodore H. Schwartz[3], John J. Foxe[1,2]; [1]Program in Cognitive Neuroscience, The City College of the City University of New York, [2]The Cognitive Neurophysiology Laboratory, Program in Cognitive Neuroscience and Schizophrenia, Nathan S. Kline Institute for Psychiatric Research, Orangeburg, [3]Weill Cornell Medical College, New York Presbyterian Hospital, New York — Over the past decade, evidence supports the view that multisensory integration occurs at the level of early sensory cortices. Furthermore, it has been shown that this interplay occurs before the involvement of well known multisensory areas further up the processing hierarchy. In the present study, we investigated the dynamic activation subsequent to the presentation of visual, auditory, and audio-visual stimuli in the human brain. To do so we recorded intracranial EEG from implanted epileptic patients undergoing pre-surgical evaluation, while they performed a stimulus detection task. We collected intracranial electrophysiological responses to each of the stimulus types (visual, auditory, and bisensory audio-visual) and computed the sum of the unisensory responses. In a preliminary analysis of data from 3 subjects, the responses revealed multisensory integration beginning at about 100ms in both visual and auditory cortices, when multisensory and summed unisensory responses were compared; whereas multisensory integration effects in higher-order multisensory regions (IPS and STS) were not observed until between 200 and 300ms. These intracranial data provide direct evidence for early onset multisensory integration in cortical areas that have traditionally been considered unisensory, effects that precede those found in higher-order multisensory regions.

C120

I KNOW WHAT YOU'RE DOING BECAUSE I DID IT BEFORE: SENSORY-MOTOR EXPERIENCE INDUCES PERIPERSONAL SPACE MODIFICATIONS DURING ACTION OBSERVATION Claudio Brozzoli[1,2,3], Lucilla Cardinali[1,2,3], Francesco Pavani[4,5], Alessandro Farnè[1,2,3]; [1]INSERM, U864, Espace et Action, Bron, France, [2]Université Claude Bernard Lyon, France, [3]Hospices Civils de Lyon, Hôpital Neurologique, Mouvement et Handicap, Lyon, France, [4]University of Trento, Italy, [5]Center for Mind/Brain Sciences, University of Trento, Italy — Electrophysiological and brain imaging studies support the existence of a mirror neurons system in humans, activated during action execution and observation of another individual's execution of the same action. We recently documented in humans a Peripersonal Space (PpS) involvement into action execution, showing on-line multisensory modulations induced by grasping objects. Here we investigated whether similar multisensory modulations may arise when merely observing the execution of prehension movements. Subjects were tested in pairs, (Observer and Actor) in each session (overall N=16). Both were requested to perform the same visuo-tactile task while fixating the centre of an object: to discriminate the elevation of tactile stimuli delivered on their right hand (up-index finger, down-thumb), while ignoring visual distractors appearing from the upper or lower part of the object. While the Actor was asked to grasp the object, the Observer passively observed the grasping action. In a separate session, the subjects' role was inverted. Results showed that Observers presented PpS modulations similar to those induced in the Actor by grasping execution. However, this effect arose only after Observers had previously experienced the Actor's role. These findings provide evidence that action perception can induce in the observer not only a motor resonance, but also a resonance of the perceptual consequences of the observed action. Intriguingly, this effect appears dependent on the observer's prior actual experience, suggesting a differential role for enacted vs. merely potential actions in the subject's motor repertoire.

C121

INVESTIGATING MECHANISMS FOR MULTISENSORY ENHANCEMENT OF VISUAL-TARGET DETECTION Ian Fiebelkorn[1,2], John Foxe[1,2], Hans-Peter Frey[1,2], John Butler[1,2], Sophie Molholm[1,2]; [1]City College of New York, [2]Albert Einstein College of Medicine — Task-irrelevant sounds improve the detection of visual targets. Here we asked whether spatial alignment is a necessary condition for such auditory enhancements of visual processing. While a number of studies have shown that spatially aligned receptive fields are required for multisensory effects, an auditory-tactile study that measured redundant-target effects suggested otherwise. In the present study, participants were asked to maintain central fixation and deploy their attention equally across three possible target locations: a location just below central fixation, and locations 14 degrees to the right and left of central fixation. Low-contrast visual targets were sometimes paired with a task-irrelevant sound presented either from a "nearby" speaker positioned on top of the monitor, or from a "distant" speaker positioned in line with the participant's left shoulder. Participants were instructed to press a button when a visual stimulus occurred at any of the three possible target locations, regardless of sounds. Visual-alone, audiovisual, and auditory-alone stimuli were equiprobable, so sounds could not be used to predict the presence of visual targets. Our results reveal that task-irrelevant sounds indeed improved the detection of visual targets despite wide spatial separations. Further, facilitation was equivalent for sounds presented from the nearby and the distant speaker. Multisensory effects on visual-target detection at the central location, however, were seemingly diminished compared to effects at the peripheral locations, particularly when a central visual target was paired with a sound that was presented at the more distant speaker. Additional experiments will probe the neurobiological underpinnings of these behavioral effects.

C122

DANCING TO THE BEAT: MEASURES OF MUSICAL BEAT-FINDING IN PERCEPTION AND ACTION Jessica Phillips-Silver[1], Petri Toiviainen[2], Nathalie Gosselin[1], Olivier Piché[1], Sylvie Nozaradan[3], Isabelle Peretz[1]; [1]BRAMS, University of Montréal, [2]University of Jyväskylä, [3]Catholic University of Louvain — Musical movement and dance are observable in almost every individual, regardless of age, culture or type of musical experience, yet this ability has received little attention from the scientific literature. The present study has three goals. First, we document the ability possessed by adults in the general population to synchronize their body movement with real music. We use a motion capture device to measure full-body movement, and demonstrate that adults are highly precise; at least as precise as they are at tapping. Second, we measure the ability of the same people to judge whether a model is dancing in time to the same music. We use a novel perceptual asynchrony detection paradigm, in which subjects judge audiovisual movies of the dancer, that are either synchronous or asynchronous to varying degrees. We show that people are proficient at this activity, though their performance on this perceptual task is less precise than on the production task. Third, we report a case of an individual with self-reported rhythm problems, who is significantly impaired on both tasks. We conclude that beat-finding in perception and action is a widespread ability that does not rely on special training. However, there exist rare cases of individuals who are impaired on beat perception and synchronization in the context of music. We explore the present case as a new form of congenital amusia, specific to beat perception and synchronization: beat deafness.

C123

CO-VARIATION OF EEG SYNCHRONIZATION AND SELF-ESTIMATION OF SPONTANEOUS EMOTIONAL STATES Miroslaw Wyczesany[1], Jan Kaiser[1]; [1]Jagiellonian University, Krakow, Poland — The current study addresses the issue of associations between cortical activity and the experiential aspect of emotional state. The focus on subjective reports differs from the typical approach where emotions are operationalized by the experimental procedure. Our previous studies have shown that EEG power patterns were specifically related to such estimation. The goal of the present study was to investigate the role of cortical emotional systems, as postulated by Heller (1993), in the emotional states experience. This model distinguishes two main cortical areas involved in emotion: the frontal region related to valence, and the right posteriotemporal region related to non-specific emotional arousal. In order to determine their functional relationships, the Synchronization Likelihood (SL) index, based on EEG generalized synchronization, was applied. Subjects rated their spontaneous emotional state with the University of Minnesota Adjective Checklist, which yielded three measures: valence, energy arousal, and tension arousal. The scores of the subjective scales were correlated with SL levels for all electrode pairs within the regions of interest. The results only partly confirmed the hypotheses based on Heller's theory. The level of negative valence was associated with increase of long-range synchronizations between T8 and many frontal and right parietal electrodes in high alpha and low beta frequency bands, while at higher frequencies, the center of synchronization was the CP2 electrode. Tension arousal was found to be negatively correlated with synchronizations within the frontal area in the alpha band. We discuss the role of cortical systems in the experience of different qualities of emotional state.

Perception & Action: Vision

C124

FUNCTIONAL COMMUNICATION WITHIN A PERCEPTUAL NETWORK PROCESSING FAMILIAR AND UNFAMILIAR VISUAL OBJECTS Anthony Herdman[1]; [1]Simon Fraser University — Many studies have identified regions within human ventral visual stream to be important for object identification and categorization; however, knowledge of how perceptual information is communicated within the visual network is still limited. Current theories on object identification posit that incoming perceptual information about an object is matched to internal representations. If there is a high correspondence then the object is identified, if there isn't then the object requires more detailed processing. This extra processing should manifest as additional activity and neural communication amongst multiple cortical regions. I examined this by using time-frequency and functional connectivity analyses of brain source data estimated from magnetoencephalographic recordings. I found that, as compared to familiar letters, unfamiliar letter-like characters (pseudoletters) elicited significantly prolonged gamma-band (50-80 Hz) activity and delayed communication between 245-375 ms amongst regions in a more distributed visual network. I also found that viewing letters produced alpha-band (9-12 Hz) desynchronization and gamma-band synchronization as early as 85 ms that wasn't evident when viewing pseudoletters. The right fusiform gyrus was a central hub of connectivity in both frequency bands, thereby illustrating the concept that neural regions decrease communication within one network while increasing it in another. These findings indicate that familiar object processing begins by at least 85 ms and doesn't persist as long as that for unfamiliar object processing. Moreover, the extra activity and distributed communication for pseudoletters might reflect perceptual binding of their novel line configurations in order to begin consolidating them into unitized templates used on subsequent viewings.

Language: Other

D1

EVENT-RELATED POTENTIALS REVEAL THE INTERPLAY OF NATIVE AND SECOND LANGUAGE DURING BILINGUAL WORD PRODUCTION
Yanjing Wu[1], Guillaume Thierry[1,2]; [1]Bangor University, [2]ESRC Centre for Research on Bilingualism in Theory and Practice — Language production in bilinguals requires the selection of words in the intended language for articulation. Although fluent bilingual speakers do not make random errors when using one of their languages, it has been suggested that they access information in both languages. However, the mechanism of word selection in bilingual speech production is a matter of debate, as argued by contradictory models. Here, we manipulated word sound repetition in picture name of the first (Chinese) and the second (English) language of proficient bilingual participants independently, while they engaged in a covert speech production (rhyming judgment) task. Event-related potentials showed that, when rhyming judgments were performed in English, target pictures rhyming in English with the prime elicited a reduction in ERP amplitude around 400 ms as compared to the control condition. Critically, target picture which rhymed in Chinese with the prime (i.e., the unintended language condition) revealed a delayed priming effect at 600 ms. When rhyming decision were made in Chinese by the same participants, picture names rhyming in Chinese elicited an N400 priming effect, but picture names rhyming in English had no effect. While the current results are consistent with previous studies showing activation of words in the unintended language, they demonstrate that word selection in bilingual speech production is asymmetrical: The intention to produce words in the second language hinders, but does not seal off, activation of the first language featuring a serial-processing mechanism. The intention to produce words in the first language appears to eliminate competition from second language.

D2

LISTENERS' PROCESSING OF PITCH ACCENTS IN ON-LINE REFERENTIAL COMMUNICATION: THE ROLE OF VISUAL AND LINGUISTIC CONTRASTS
Sara Bögels[1], Herbert Schriefers[1], Wietske Vonk[2,3], Dorothee J. Chwilla[1]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, [2]Max Planck Institute for Psycholinguistics, Nijmegen, [3]Center for Language Studies, Radboud University Nijmegen — Previous research on referential communication has shown that speakers mark linguistic contrasts with a pitch accent. After producing "the red ball", they will produce "the BLUE ball", accenting the new, contrastive information. Conversely, speakers do not mark visual contrasts with an accent; when a red ball is simultaneously present in the visual context, they will not accent the color in "the blue ball". We investigated whether listeners are sensitive to the congruous or incongruous marking of either kind of contrast with pitch accents, using Event-Related Potentials. In one block, participants were presented with linguistic contrasts (e.g., the referential utterance "the red ball" in trial N-1), followed by a congruous ("the BLUE ball"), incongruous ("the blue BALL"), or neutral referential utterance in trial N. In another block, participants were presented with visual contrasts (e.g. a display with a red and blue ball) followed by the same utterances. The results for the linguistic contrast seem to show that listeners are sensitive to accentuation; the ERPs showed a negativity for incongruous as compared to congruous accents on the adjective, but no effect for deaccented adjectives. For accents on the noun and in the visual contrast condition, no effects of congruity of the accent could be shown. Instead, we found negativities that seem to reflect other factors such as overspecification and word repetition. In conclusion, listeners seem to be more sensitive to marking of linguistic than visual contrast with pitch accents. This suggests that listeners can use exactly these markers that speakers actually produce.

D3

NEURAL CORRELATES OF PHONOLOGICAL AND SEMANTIC PRIMING
Isabelle Deschamps[1], Pascale Tremblay[2], Natalie Phillips[3], Shari Baum[1], Vincent Gracco[1,4]; [1]McGill University, Montréal, Quebec, [2]The University of Chicago, Chicago, [3]Concordia University, Montréal, Quebec, [4]Haskins Laboratories, New Haven, CT — Differences in brain activation between semantic or phonological priming are often observed in studies requiring a lexical decision. The brain areas most often reported include the middle temporal lobe, the inferior frontal gyrus and the left posterior temporal cortex. In this fMRI study, we examined the neural correlates of passive semantic and phonological priming, as well as priming in a task of target word production. The goal of the study was three-fold: 1) to investigate the cortical networks associated with word recognition mechanisms during semantic and phonological priming; 2) to discover whether evidence of passive phonological and semantic priming would emerge (in the absence of a task); and 3) to investigate whether the cortical areas associated with phonological or semantic priming differ when the target word is verbally produced(articulated) or not. Stimuli consisted of pairs of words presented visually in succession in three conditions (semantically related, phonologically related, unrelated) across two tasks (passive reading and word naming). A resting baseline was also acquired via a 1.5T Siemens scanner. Results demonstrated that passive semantic priming activated frontal and prefrontal regions in the LH, including BA 9, 45 and 46, along with multiple distributed activations along the STS. Passive phonological priming also resulted in LH activation, stronger than in the semantic priming condition. Two areas of overlap along the STS were noted, along with two areas which were only activated in the phonological condition. Fewer differences were observed in the production task, although semantic priming resulted in greater activation than phonological priming.

D4

SENSOR AND SOURCE SPACE CORRELATES OF PREDICTION VIOLATIONS IN PHONOLOGICAL PROCESSING
So-One Hwang[1], Philip Monahan[1,2], William Idsardi[1]; [1]University of Maryland, [2]Basque Center on Cognition, Brain and Language — Listeners use fine acoustic cues in the speech signal to make predictions about upcoming segments (Hwang et al. 2008). On single vowel tokens, Obleser et al. (2004) demonstrated that the M100 latency and equivalent current dipole source location are sensitive to featural differences between vowels. We expect that these measures will

also reflect on-line processing of featural information. Here, we compare the neuromagnetic response to phonologically identical vowels in contexts where the preceding consonant is either predictive or misinformative of that vowel. In English, the dorsal consonant [g] is produced further forward in the mouth ([g+]) when preceding FRONT vowels (e.g., [? e]) than BACK vowels (e.g., [? ?]). We constructed matched or mismatched stimuli by splicing or cross-splicing [V?] frames onto [g] and [g+]. Subjects were asked to identify the vowel while their brain activity was recorded (157-channel whole head axial gradiometer MEG, KIT, Japan). For the back vowel tokens, a significantly shorter M100 peak latency was elicited to the match compared with the mismatch token (LH: n=13, p<0.01; RH: n=11, p<0.001) but no difference between the front vowel tokens (LH: p=0.33; RH: p=0.08). Consistent with this asymmetry, we find a significant difference in the ECD source estimation, where only back vowel mismatches elicited a reliably more posterior center of activation along the posterior-anterior axis in the left hemisphere (p<0.05). In conclusion, listeners use fine acoustic cues to generate predictions about the upcoming speech signal, and these are reflected in both sensor and source space analyses.

D5

LANGUAGE INVARIANT VERB PROCESSING REGIONS IN SPANISH-ENGLISH BILINGUALS Joanna L. Willms[1,2], Kevin A. Shapiro[1,3], Petra E. Pajtas[1], Lauren R. Moo[1,2], Alfonso Caramazza[1,4]; [1]Harvard University, [2]Massachusetts General Hospital, [3]Children's Hospital Boston, [4]Center for Mind/Brain Sciences, University of Trento, Italy — Nouns and verbs are universal components of language. The differential processing of these grammatical categories has been documented in many languages in patients and in healthy participants. Following up studies of bilingual patients who show impairment for either nouns or verbs in both languages, we investigated the cortical organization of grammatical categories in healthy bilinguals using functional magnetic resonance imaging (fMRI). Highly proficient Spanish-English bilinguals completed a simple morphosyntactic task in both languages. Four regions showed greater activity for verbs than for nouns across languages: left posterior middle temporal gyrus (BA 22/39), supplementary motor area (BA 6 and 8), left middle frontal gyrus (BA 9, 46, and 6), and a small cluster in the right middle occipital gyrus (BA 18). While in region of interest analyses (but not whole brain analyses) overall activity was higher for Spanish, this may be due to participants' more frequent use of English as adults. The absence of interactions between language and grammatical category in these regions indicates that the increased activity for processing verbs compared to nouns is driven by both languages. Thus, the processes underlying the differential response to nouns and verbs may have a language invariant neural basis.

D6

LOCALIZATION OF SUBLEXICAL SPEECH PERCEPTION COMPONENTS Peter Turkeltaub[1], H. Branch Coslett[1]; [1]University of Pennsylvania — Models of speech perception are in general agreement with respect to the major cortical regions involved, but lack precision with regard to localization and lateralization of processing units. To refine these models we conducted two Activation Likelihood Estimation (ALE) meta-analyses of the neuroimaging literature on sublexical speech perception. Based on foci reported in 18 fMRI experiments comparing sublexical speech perception to nonspeech auditory stimuli, we identified significant activation likelihoods in left and right superior temporal cortex and the left precentral sulcus, corresponding to the premotor mouth area. Subanalysis of phonetic perception studies revealed a single cluster in the left superior temporal sulcus. A lateralization analysis demonstrated clear left lateralization of the temporal lobes in terms of magnitude, extent, and consistency of activity. A second ALE analysis of eight fMRI studies on perception of differences between phoneme categories revealed significant activation likelihood in the left supramarginal gyrus and angular gyrus. The results are consistent with a speech processing network in which the bilateral superior temporal cortices perform acoustic analysis of speech and nonspeech auditory stimuli, the left superior temporal sulcus performs early phonetic analysis, and the left inferior parietal lobule is involved in detection of differences between phoneme categories. These results modify current speech perception models in three ways: 1) specifying peak locations and extents of dorsal stream processing units, 2) clarifying that phonetic superior temporal sulcus processing is left lateralized, and 3) demonstrating that both the supramarginal gyrus and angular gyrus are involved in phoneme discrimination.

D7

NEURAL SUBSTRATES OF SIMULTANEOUS LANGUAGE INTERPRETATION Alexis Hervais-Adelman[1], Barbara Moser-Mercer[1], Christoph Michel[1,2], Frédéric Grouiller[1,2], Narly Golestani[1]; [1]Universté de Genève, [2]Hôpitaux Universitaires de Genève — Twelve trainee simultaneous language interpreters (mean age: 27 years; 4 female; 11 right-handed) took part in a functional magnetic resonance imaging investigation of simultaneous interpretation. They were presented with sentences during silent intervals of a sparse imaging paradigm (TA: 2040ms, TR: 9s; 36 slices, 3mm thick, 0.6mm interslice gap). Participants were asked to either listen to, shadow (repeat sentences as they heard them) or to simultaneously interpret (into their native language) the stimuli, between scans. Stimuli were divided into mini-blocks of 4 thematically-linked sentences (simulating a more natural interpretation scenario). We also included null-events (silence), to measure baseline activation. Conditions were pseudo-randomized such that a given condition never occurred more than twice in succession. We acquired 3 blocks of 65 scans (13 quartets of sentences and 13 null-events), each lasting 10 minutes. A comparison of the interpretation versus shadowing conditions revealed significantly (familywise error-corrected p<0.05) greater activation in a left-prefrontal network, comprising the left pars triangularis (a subregion of Broca's area), left supplementary motor area and ventral left precentral gyrus. These regions have previously been implicated in speech-motor planning, and Broca's area has been associated with grammatical processing and verbal working memory. At a lower significance threshold (uncorrected p<0.001) additional activations are seen in the left anterior insula, and bilateral caudate nuclei. The caudate nuclei have previously been shown to be involved in language switching. Results suggest that simultaneous interpretation implicates additional involvement of regions involved in speech-motor control, language switching, verbal working memory, and grammatical processing than simultaneous repetition.

D8

'HELLO' IS ALL YOU NEED: NEUROMAGNETIC EVIDENCE OF DIALECT EXTRACTION Mathias Scharinger[1], Philip Monahan[1,2], William Idsardi[1]; [1]University of Maryland, [2]Basque Center on Cognition, Brain and Language — The time-course and cortical mechanisms underlying speaker dialect perception remain poorly understood. We present evidence suggesting that dialect information is extracted in pre-attentive speech processing and reflected in the evoked mismatch negativity response (MMN/MMNm; Näätänen, et al. 2007). The MMN has been elicited to talker change (Titova & Näätänen, 2001; Beauchemin, et al. 2006) and has also been used to identify parallel processing of word and voice information (Knösche, et al. 2002). Here, participants (n=12; mean age = 22.9 yrs) passively listened to 20 acoustically distinct, randomly presented tokens of 'hello' produced in two separate dialects by a single bi-dialectal speaker (10 Standard American English (SAE); 10 African-American Vernacular English (AAVE)). We employed a many-to-one mismatch oddball paradigm (deviant p=0.125) with tokens from each dialect serving as the deviant in half the session. Neuromagnetic activity was recorded by a 157-channel whole-head MEG system (KIT, Japan). Based on 10 left hemisphere channels sampled per participant, we calculated the grand average RMS waveforms to the standards and deviants of each dialect. In the first MMNm time window (125-175ms) we find a reliable MMNm in the AAVE standard-deviant comparison (p<0.001) but no difference in the SAE comparison (p=0.19). In the second MMNm time window (175-225ms), we find a difference in both the AAVE (p<0.001) and the SAE comparison (p<0.001). Since the deviants shared talker, voice and linguistic properties with the standards, differing solely on dialect, the elicited MMNm demonstrates that dialect information is extracted in preattentive speech processing.

D9

POSTERIOR N1 ASYMMETRY TO ENGLISH AND WELSH WORDS IN EARLY AND LATE ENGLISH-WELSH BILINGUALS Giordana Grossi[1], Nicola Savill[2], Enlli Thomas[2], Guillaume Thierry[2]; [1]State University of New York at New Paltz, [2]Bangor University — We investigated the lateralization of the posterior event-related potential N1 component (120-170 ms) to written words in two groups of bilinguals. Fourteen early English-Welsh bilinguals and 14 late learners of Welsh performed a semantic categorization task on English and Welsh words presented in separate blocks. Words in the two languages were matched on length, frequency, within-language neighborhood density, cross-language neighborhood density, and bigram frequency. In both groups, the N1 was strongly lateralized towards the left posterior scalp for both languages. A robust correlation was found between N1 asymmetry for English and N1 asymmetry for Welsh words in both groups. Furthermore, in late bilinguals, there was a trend for the N1 asymmetry for Welsh to correlate with years of experience in Welsh. These data suggest that, in late bilinguals, the degree of lateralization of systems involved in written word recognition for the second language is associated with the neural organization for the first language, and that increased experience with a second language is associated with a larger left-right functional asymmetry. Future research will investigate whether the correlations in the two groups reflect similar or different mechanisms depending on the age of acquisition of the second language.

D10

THE PHONEMIC RESTORATION EFFECT REVEALS PRE-N400 EFFECT OF SUPPORTIVE SENTENCE CONTEXT IN SPEECH COMPREHENSION David M. Groppe[1], Marvin Choi[1], Tiffany Huang[1], Ben Topkins[1], Joseph Schilz[1], Marta Kutas[1]; [1]University of California, San Diego — The phonemic restoration effect (Warren, 1970) refers to the tendency for people to hallucinate a phoneme that has been replaced by a non-speech sound (e.g., a tone) in a word. This illusion can be influenced by preceding sentence context that provides information about the likelihood of the missing phoneme (Samuel, 1981). The saliency of the illusion suggests that supportive sentence context can affect relatively low levels of speech processing (e.g., the phonemic level or lower). Indeed, an event-related potential (ERP) investigation of the phonemic restoration effect by Sivonen et al. (2006) found that the processing of coughs that replaced high probability versus low probability phonemes in sentential words differed from each other as early as 120-180 ms post-stimulus. However, this result was confounded by physical differences between the high and low probability speech stimuli. Thus, their effect could have been caused by factors such as habituation and not by supportive sentence context. We conducted an ERP experiment similar to that of Sivonen et al., but we avoided a confound of auditory stimulus differences by using the exact same auditory stimuli preceded by text that made critical phonemes more or less probable. As with their previous study, we found a robust N400 effect of phoneme/word probability, but no early 120-180 ms effect. We did however observe a left posterior effect of phoneme/word probability around 190-225 ms -- clear evidence of an early effect of supportive sentence context in speech comprehension distinct from the N400.

D11

AN ERP STUDY OF CROSS-MODAL RHYMING: INFLUENCES OF PHONOLOGY AND ORTHOGRAPHY Priya Mitra[1,2], Donna Coch[2]; [1]Tufts University, [2]Dartmouth College — Previous visual and auditory event-related potential (ERP) studies using prime-target pairs of word and pseudoword stimuli have reported a robust rhyming effect such that nonrhyming targets elicit a larger N400 than rhyming targets. Few studies have investigated this ERP rhyming effect in cross-modal paradigms, or have explored the possible influences of orthography on the N400 rhyming effect for auditory stimuli. We presented college students (N = 20) with visual pseudoword primes and auditory real word targets, half of which rhymed and half of which did not rhyme with the primes. Half of the auditory targets in the rhyming condition also shared rime spellings with the visual primes (e.g., nain-gain) while half were orthographically mismatched with the primes (e.g., tain-sane). A typical N400 rhyming effect was apparent in mean amplitude analyses within the 350-600 ms time window following onset of the target words, especially at right hemisphere, posterior, medial sites ($p < .01$). Comparison of ERPs to rhyming trials for targets orthographically matched and orthographically mismatched to primes revealed that orthography affected mean amplitude at left hemisphere sites within the 350-600 ms window ($p < .05$). These results demonstrate that pseudoword-word pairs can elicit a typical N400 rhyming effect between modalities. Further, they indicate that fluent adult readers access orthographic information during the phonological analysis of auditory words in a rhyme judgment task. The different topographical distributions of the orthographic effect and the phonological effect suggest different underlying neural generators for these concurrent effects.

D12

A BROKEN LINK WITH THE BROCA'S AREA IN PERSISTENT DEVELOPMENTAL STUTTERING Chunming Lu[1], Wenping You[1], Xuhui Zhang[1], Guosheng Ding[1], Danling Peng[1]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, P. R. China — Despite the extensive neuroimaging studies on persistent developmental stuttering (PDS), the neurological genesis of PDS is still unclear. While the severity of stuttering always changes, task-induced brain abnormalities could not reveal the common neural bases of PDS across various speech conditions. The present study, for the first time, examined the resting state functional connectivity (rsfc) of 15 PDS participants and 13 controls by using an ICA approach, and validated the rsfc data by cortical thickness examination. The rsfc results revealed reduced rsfc strength in the left Broca's areas (BA44/45) and superior temporal sulcus (BA21), and increased rsfc strength in the left inferior parietal gyrus (BA7) and declive of the cerebellum relative to the controls. Cortical thickness results confirmed the rsfc results in the left Broca's area by showing significant cortical thinning. Further, there was a significant correlation between the cortical thinning data and the reduced rsfc strength data across participants. These results reliably indicate that the neural abnormality in the Broca's area may play a key role in the neurological genesis of PDS. This finding is helpful in understanding the pathology of PDS and evaluating the treatment methods of PDS.

D13

ERP AND FMRI REFLECTIONS OF LANGUAGE MONITORING: THE CASE OF SPELLING ERRORS Nan van de Meerendonk[1], Peter Indefrey[1,2,3], Herman H. J. Kolk[1]; [1]Donders Institute for Brain, Cognition and Behaviour, [2]Heinrich-Heine-Universität Düsseldorf, [3]Max Planck Institute for Psycholinguistics — According to the monitoring theory of language perception (e.g., Kolk et al., 2003) competing representations that are caused by strong expectancy violations can trigger a conflict. This conflict elicits reprocessing of the input to check for possible processing errors, which is reflected by the P600 component in the EEG. The present study was set up to investigate this monitoring process, both in the EEG and fMRI, comparing syntactic and spelling violations. In addition, to assess the effect of conflict strength, misspellings were embedded in sentences that were either highly or lowly predictive for a critical word. In the EEG, both spelling and syntactic errors elicited similarly distributed P600 effects. In accordance with the monitoring theory, the P600 effect was larger to misspellings in the highly compared to the lowly predictive sentences. In the fMRI study, spelling and syntactic errors led to a stronger activation in the same subregion of the left inferior frontal gyrus (lIFG); the strength of the two activation levels did not differ. For the misspellings, there was no difference between highly and lowly predictive sentences, as was observed in the EEG. Furthermore, misspellings activated other areas, besides lIFG. The results suggest that the P600 effects and lIFG activation reflect processes of monitoring and control of language, rather than language processing as such. In addition, they might reflect different components of the monitoring process; while the P600 component is sensitive to conflict strength, the LIFG directs reprocessing whenever the strength of this conflict is of a sufficient size.

D14

SPEECH PERCEPTION AND LANGUAGE LEARNING EXPERIENCE: COMPARING MONOLINGUALS, BILINGUALS AND MULTILINGUALS Marie-Claude Tremblay[1]; [1]University of Ottawa — Studies have shown that bilinguals and multilinguals have superior learning and processing skills (Nation & McLaughlin, 1986; Nayak et al., 1990; Thomas, 1988; 1992; M.-C. Tremblay, under review). The aim of the present study is to determine whether language learning experience also contributes to the development of greater perceptual sensitivity to non-native speech contrasts. To date, the limited body of research, which is comprised of behavioural data only, provides mixed results, sometimes showing advantages for bilinguals/multilinguals over monolinguals (Enomoto, 1994), other times not (Gallardo del Puerto, 2007). Moreover, these studies only look at initial perceptual abilities, ignoring the potential impact of learning experience on learning rates (Werker, 1986). Combining behavioural (i.e. AX discrimination task) and electrophysiological (i.e. event-related potential experiment using an oddball paradigm) methods, monolinguals, bilinguals and multilinguals are compared in their ability to discriminate a non-native contrast (voiceless aspirated dental/retroflex stop) before and after receiving training as well as in their ability to transfer this training to a new but similar contrast (voiceless unaspirated dental/retroflex stop). The results of the behavioural experiment indicate that performance on the discrimination task improves as a function of language learning experience after training only. At the neurophysiological level, the effect of experience is observed both initially and after training. The results confirm that language learning experience boosts perceptual abilities and learning rates. The results also indicate that neurophysiological changes may transpire before or in the absence of behavioural changes (K. L. Tremblay et al., 1998; present study).

D15

RHYTHMIC REGULARITY IN CONTINUOUS SPEECH PROCESSING Nicolas Planet[1], Kimberly Ethridge[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst — Previous event-related brain potential (ERP) research has shown that lexical recognition allows listeners to preferentially process the initial segments of words in continuous speech, as indexed by N1 amplitude. However, these studies employed artificial languages with words composed of a regular number of syllables such that training may have made both rhythmic regularity and familiarity available as cues to boundaries between words. The current study manipulated rhythmic regularity by employing two artificial languages: one comprised six three-syllable words and the other two two-syllable, two three-syllable, and two four-syllable words. EEG was recorded as participants listened to a continuous stream of one of the languages. A behavioral recognition test was given before participants were explicitly trained to recognize the words and EEG was recorded as the same language was presented again. Participants who heard the consistent word-length language evidenced a larger N1 and N400 time-locked to word onsets after compared to before training, replicating previous results. The other group showed a larger N400 after training, but no differences in the early perceptual processing of the word onsets in continuous speech. These results suggest that rhythmic regularity plays an important role in the preferential processing of sequence-initial information in continuous streams of newly-learned nonsense words.

D16

PHONOLOGICAL REPRESENTATION IN CHILDHOOD APRAXIA OF SPEECH (CAS): AN ERP STUDY Reem Khamis-Dakwar[1], Mellisa Randazzo[2], Karen Froud[2]; [1]Adelphi University, [2]Teachers College, Columbia University — Childhood Apraxia of Speech (CAS) is commonly defined as a motor planning disorder (Edwards, 1984). However, it has been suggested that CAS may result from overspecification of phonological representations (Dogil, Mayer, & Vollmer, 1994). To evaluate this hypothesis, we investigated auditory MMN responses from children with CAS and typically-developing controls (aged 6-7 years). CV syllables were presented in randomized order in two passive-listening oddball paradigms, phonemic (/ba/, /pa/) and allophonic (/pa/, /pha/), with /pa/ always representing the standard (145 trials per condition, 17% deviants). MMN was derived from high-density EEG recordings by averaging and montaging to fronto-central sensors, and subtraction of averaged standard responses from averaged deviant responses within each condition. In the phonemic contrast condition, increased MMN amplitude was associated with deviant stimuli for children in the control group but not children with CAS. The control group also showed a significant later negativity (300-400 msec) in this condition, but the CAS group showed a positivity in the same time window. The allophonic condition did not elicit MMN effects for either group, but the CAS group showed a positivity throughout the epoch (up to 400 msec) in this condition. Since positive-going potentials are sometimes observed in the MMN time window during early language development (Conboy, Rivera-Gaxiola, Silva-Pereyra, & Kuhl, 2008), this result may index an immature pattern of MMN responses by children in the CAS group. We propose that these preliminary findings are consistent with a view of CAS as a disorder affecting underlying phonological representations.

D17

EARLY NEURAL RESPONSES SHOW SENSITIVITY TO SONORITY DIFFERENCES IN CONSONANT CLUSTERS Pedro Alcocer[1], William Idsardi[1]; [1]University of Maryland — To what extent does our knowledge of the constraints governing the sequencing of speech sounds influence early auditory cortical processing? Sonority is a property of speech sounds that is associated with their relative loudness and resonance. Across languages, it has been observed that word-initial consonant clusters with increasing sonority are more frequent that those with decreasing sonority (e.g., [dl] is more common than [ld]). This preference has been called the sonority sequencing constraint. Using MEG and the magnetic mismatch field response (MMF), we investigate whether a preference for rising sonority is reflected in early automatic processing in auditory cortex. We employ an MMF-eliciting design comparing the neural response to [dlif] and [delif] in the rising sonority condition and [ldif] and [ledif] in the falling sonority condition. Stimuli were created by recording disyllabic tokens ([delif] and [ledif]) and splicing out the first inter-consonantal vowel ([dl], [ld] do not exist in English). Native English-speaking participants passively listened to stimuli presented in an oddball paradigm during MEG recording. Four blocks were run: two using monosyllabic tokens as the standard and two using disyllabic tokens as standard. We find that the rising sonority tokens consistently elicit an MMF with an onset at 200ms, suggesting that participants are able to perceptually distinguish [dlif] from [delif]. Crucially, however, we find an asymmetrical MMF response, suggesting that participants do not perceive [ldif] and [ledif] differently. This finding indicates that the SSC is operative early in phonological processing and can influence early automatic responses in auditory cortex.

D18

FREQUENCY, NOT UNDERSPECIFICATION, DRIVES MMF ASYMMETRIES TO DEVIANT SYLLABLES Joshua Riley[1], Mary Ann Walter[2], Valentine Hacquard[1], William Idsardi[1]; [1]University of Maryland, College Park, [2]Northwestern University — The magnetic mismatch field (MMF) response, an electrophysiological measure of perceptual distance and the MEG equivalent of the mismatch negativity response, exhibits order-of-presentation asymmetries when naturally-produced syllables are used. For example, a deviant /ga/ following a sequence of /ba/ elicits a greater amplitude MMF than a physically identical deviant /ba/ following a sequence of /ga/[1]. We present a series of studies that we argue support an explanation for this phenomenon that relies crucially on segmental frequency, namely a transition from a low probability stimulus to a high probability stimulus eliciting a larger amplitude MMF than vice versa. This contradicts previous accounts of perceptual ordering asymmetries relying on phonemic underspecification [1,2]. While segmental frequency and featural underspecification have proved difficult to disentangle, English and Amharic have different relative frequencies for phonologically similar syllables, thus making different predictions for Amharic and English speakers listening to the same stimuli. We present a series of studies that suggest that frequency differences explain these asymmetries in English and Amharic. Our first finding that coronal deviants produce larger amplitude MMFs than labial deviants is inconsistent with underspecification accounts. Our second study contrasts across manner of articulation (nasal v. oral) rather than place with the same stimuli and suggests that frequency effects drive the previous result. Finally, we present our cross-linguistic evidence and find a significant effect of native language on these MMF asymmetries. Taken together, underspecification accounts cannot explain our pattern of results for English and Amharic speakers.

D19

GRASPING TIME – HOW TEMPORAL ALIGNMENT AFFECTS GESTURE SPEECH INTEGRATION Christian Obermeier[1], Thomas C. Gunter[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — In everyday face-to-face conversation, speakers not only use speech to convey information but also rely, amongst others, on co-speech gestures. Various studies have shown that, for instance, iconic gestures can affect speech comprehension. Although being widely recognized as one of the crucial factors for gesture-speech integration, the temporal aspects of this process have been understudied so far. In the present experiment, we explored the significance of timing for gesture-speech integration using a disambiguation paradigm. Participants were presented with short video clips of an actress uttering sentences like 'She was impressed by the BALL, because the GAME/DANCE…'. The ambiguous noun was accompanied by a dynamic iconic gesture fragment containing the minimal necessary amount of information to disambiguate the noun. We used four different temporal alignments between the noun and the gesture fragment: the uniqueness point of the noun was either prior (+120 ms condition), synchronous with (0 ms condition) or lagging behind the end of the gesture fragment (-600 ms/-200 ms conditions). ERPs triggered to the uniqueness point of the noun (i.e. BALL, immediate integration) showed that integration with the gesture fragment depended on timing, as all but the -600 ms condition resulted in N400 effects. In contrast, ERPs elicited at the later target word position (i.e. GAME/DANCE, delayed integration) showed N400 effects independent of timing. Thus, although there seems to be a crucial time window for immediate gesture speech integration, even gesture information present beyond this time window can exert a disambiguating influence.

D20

TASK MODULATED NEURAL ACTIVATION PATTERN IN CHRONIC STROKE PATIENTS WITH APHASIA Rajani Sebastian[1], Swathi Kiran[2]; [1]University of Texas at Austin, TX, [2]Boston University, MA — Functional neuroimaging (fMRI) studies on post stroke aphasia suggest that when perisylvian regions are damaged in stroke, their linguistic functions may be taken over by other areas, supporting recovery from aphasia. In patients with aphasia, both perilesional and contralesional activations are commonly observed, with much variability across individuals. The significance of contralesional activation is hotly debated due to variation in a number of factors, including lesion site, phase of recovery, difficulty of the task, and performance accuracy. The relationship between task with varying difficulty level and neural activation patterns have seldom been assessed within the same individuals. In the present study, we examined neural activation patterns with two tasks with varying level of difficulty (picture naming and semantic judgment) on 8 high functioning chronic participants with aphasia with varying site/size of lesion (anterior lesion, posterior lesion and anteroposterior lesion). In healthy control participants, semantic judgment task elicited robust left-lateralized frontal activation, where as picture naming task elicited bilateral activation. For participants with aphasia, activation during semantic judgment task involved mainly the perilesional or undamaged regions in the language dominant hemisphere. During picture naming task, participants with aphasia showed increased right temporoparietal and/or right frontal activation in addition to the perilesional/ipsilesional activation irrespective of the site of lesion. The additional activation observed in the temporoparietaland/or right frontal region during picture naming for the participants could be attributed to increased processing demands. The results of this study revealed a complex relationship between task difficulty, site of lesion, and size of lesion.

D21

WORD RECOGNITION AFFECTS EARLY PERCEPTUAL PROCESSING OF SUBSEQUENT ONSETS IN CONTINUOUS SPEECH Lori B. Astheimer[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst — Event-related brain potential (ERP) evidence indicates that listeners preferentially process word onsets during continuous speech perception, as indexed by a larger N1 elicited by word-initial compared to physically similar word-medial syllables. The current study explored the mechanism by which word recognition affects the processing of word onsets using an artificial language training paradigm. EEG was recorded in an initial exposure phase while participants listened to a 30-minute stream of twelve three-syllable nonsense words presented as continuous speech. Participants were then trained to recognize half of the words. Upon reaching a strict learning criterion, participants underwent a second EEG recording while listening to the same syllable stream again, which at that point contained six trained words arranged randomly among six untrained words. Behavioral results indicate that participants were only able to recognize trained words; performance on untrained words remained at chance even after the second exposure phase. ERP results demonstrate that early perceptual processing of word onsets is modulated by recognition of the words that precede them. That is, after training, early ERP differences were observed in response to both trained and untrained words that were preceded by trained words. These differences were absent for words preceded by untrained words. Conversely, later effects (N400) were observed in response to trained items only. Results indicate that the recognition of one word directs processing resources to upcoming onsets, a mechanism which is likely important for preferentially processing the most relevant information in rapidly changing streams of continuous speech.

D22

MORPHOLOGY AND TOPOGRAPHY OF THE MISMATCH RESPONSE (MMR) TO NONLINGUISTIC AND BASIC SPEECH STIMULI IN 7-MONTH-OLD INFANTS Cynthia P. Roesler[1], Teresa Realpe-Bonilla[1], Naseem Choudhury[1,2], Jennifer T. Friedman[1], Zhenkun Gou[1], April A. Benasich[1]; [1]Rutgers University, [2]Ramapo College of New Jersey — An infant's ability to efficiently detect transient changes in the auditory environment has been shown to be predictive of language abilities. These effects have been demonstrated with basic speech stimuli (consonant-vowel [CV] discrimination) as well as nonlinguistic stimuli (tone frequency discrimination). However, the question remains as to whether processing of complex tones is concurrently associated with speech discrimination abilities. Thus, we compared differences in waveforms of event related potentials (ERPs) to tones and CV stimuli, in the same typically developing 7-month-old infants (N=11), to determine how tone processing might be associated with language-based discrimination abilities. Two passive auditory oddball paradigms were presented: a complex tone-pair block (Standard stimulus = 800-800 Hz [85%]; deviant stimulus = 800-1200 Hz: interstimulus interval = 70 ms) and a CV-discrimination block (standard stimulus = /da/ [85%]; deviant stimulus = /ta/). Peak latencies and amplitudes of the P1, N1 and MMR were obtained from standard and deviant waveforms. Results suggest significant associations in peak latency (rs=.67-.80) and amplitude (rs=.67-.74) for obligatory responses (P1 and N1) to the standard stimuli. Significant associations in peak latency to the deviant stimuli were also found for P1 and N1 (rs=0.73 and 0.80, respectively) and for amplitude of the MMR (r=0.78). Most of the associations for standard and deviant peaks were located in midline and left frontal and frontocentral areas. These findings suggest that individual differences in tone processing are most robustly associated with speech discrimination abilities in areas that are traditionally associated with language processing.

D23

SHORT- AND LONG-TERM MEMORY CONTRIBUTIONS TO AUDITORY CHANGE DETECTION: A NEUROCOMPUTATIONAL MODEL Max Garagnani[1], Friedemann Pulvermuller[1]; [1]MRC Cognition & Brain Sciences Unit — The critical ability of the brain to automatically detect rare, salient auditory events amongst common ones is well-illustrated experimentally by the mismatch negativity (MMN), an event-related response elicited in oddball experiments which is larger for rare (deviant) acoustic events than for frequently repeated ones. Recent evidence, however, indicates that amongst the deviant stimuli, familiar items (e.g., words) produce larger MMN responses than unfamiliar ones (e.g., pseudowords). While several mechanistic models can explain the former (change detection, or CD-MMN) data, no computational account exists for the latter. To explain these findings, we propose that the brain response to sounds includes two components: one resulting from short-term memory (STM) processes (neuronal adaptation, lateral inhibition), producing the former (CD-MMN) effects, and one reflecting re-activation of long-term memory (LTM) traces for familiar sensory material, underlying the latter (long-term memory, LT-MMN) effects. Taking language as our working domain, we implemented a neurobiologically-grounded neural-network model of the areas involved in speech processing, modelling both short- (adaptation, inhibition) and long-term (Hebbian synaptic plasticity) cortical mechanisms. After teaching the network a limited set of artificial words, we simulated MMN responses in it, modulating strength of adaptation and inhibition. While both of these mechanisms produced CD-MMN effects, adaptation-only networks failed to replicate LT-MMN data. The present model of memory and perception provides the first unifying account for CD- and LT-MMN neurophysiological data, elucidates the role of putative mechanisms underlying LTM and STM components, and shows how inhibition- (but not adaptation)-based accounts can explain brain responses reflecting auditory change detection.

D24

THE SYLLABLE AS A RELEVANT UNIT FOR SPEECH PERCEPTION – AN ERP STUDY Heidrun Bien[1], Pienie Zwitserlood[1,2]; [1]Institute for Psychology, University of Muenster, Germany, [2]Otto-Creutzfeldt Center for Cognitive and Behavioral Neuroscience, University of Muenster, Germany — Recently, there is a revival of interest in the syllable as a relevant pre-lexical unit in speech perception, mediating between the acoustic speech input and the word form representations in the mental lexicon, with varying findings across languages and methods. In a lexical decision task, German native participants had to decide, by button press, whether a stimulus they had just heard was a word or a pseudo-word. Each target stimulus (such as lustig – engl. funny)) was preceded by a spoken prime fragment with varying overlap to the target: a) identical to its first syllable (/lus/), b) overlap (/lu/ or /lust/), and c) no overlap (/haf/). The latter condition was more frequent than the others, and we added a few trials with only initial overlap (/lop/). In order to study the pre-lexical locus of syllabic effects, the same logic of priming was applied to both words and pseudo-words, which occurred equally often in the experiment. We analyzed both the response latencies and the ERPs to the target words, expecting faster responses and reduced amplitudes in the P350 component in overlapping compared to none-overlapping conditions, with an extra bonus for syllabic overlap. As expected, words were generally responded to faster, and with less negative ERPs than pseudo-words. In the latencies, effects of overlap were significant for words only, while in the P350, they showed for both words and pseudo-words. For German, this suggests a status of syllables as representational categories in speech perception.

D25

THUMBS-UP FOR A HAPPY FACE: EMOTIONAL EMBLEM PRIMING Thomas Gunter[1], Christian Obermeier[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Emotion plays an important role during communication. During a positive event (e.g. a woman won a prize), one would not be too surprised to see someone having a happy expression on her face while simultaneous expressing her happiness soundless by using the thumbs-up emblem. This experiment explores in how far emotional faces can prime certain emblems. We used happy and angry faces of 5 male and female persons as prime stimuli. They were presented for 800 ms. After an ISI of 300-400 ms (random) an emblem (positive: thumbs up, ok-sign; negative: thumbs-down, middle-finger) or a meaningless hand posture was presented for 800 ms. The emblem was either congruent or incongruent with the emotion expressed in the face. After 500 ms participants had to decide whether the hand posture had meaning or not. A completely balanced design was used with the factors face (2), meaningfulness (2), and emblem type (2). The ERPs on the hand postures showed a long lasting negativity for the incongruent condition which started around 300 ms with a fronto-central scalp distribution. This effect was most prominent for the negative hand postures. These data show that emblems can be primed by faces and that emotional content plays a role. Implicitly, one could argue that part of the complex informational content of emblems is emotionally in nature.

D26

CAN ABSTRACT POINTING GIVE YOU DIRECTIONS IN A VERBALLY AMBIGUOUS SITUATION? J. E. Douglas Weinbrenner[1], Thomas C. Gunter[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences — It was explored whether abstract pointing gestures (APs) can resolve an ambiguous situation during speech comprehension. Contrary to concrete pointings, APs are directed to physically empty space while talking about a certain object. The object's meaning is assigned to the empty space by the pointing gesture itself. Participants watched a video, where an interviewer and an interviewee talked about various dualistic topics like "Donald Duck and Mickey Mouse". During her responses, the interviewee conducted APs and established a certain gesturing order, e.g. "Donald – left pointing" and "Mickey – right pointing". Verbally, her last response to a particular topic was at first ambiguous, but finally explicit. Asked for who is more popular with kids, for example, she answered "Maybe this character? I think I have read once that there is a higher circulation for Donald Duck comic books." At the ambiguous part ("this character"), the interviewee made an AP, which was either congruent with the later on verbal disambiguation ("Donald") or incongruent. In a third condition, the gesture could not be seen, as the camera was still on the interviewer. Event-related potentials triggered to the onset of the disambiguating word were analyzed. Preliminary results of 30 subjects show a positive deviation for the incongruent condition compared to the no-gesture condition between 550 and 750 ms after word onset. This finding indicates that APs were processed when presented during the ambiguous phase of the context. We interpret this P600-like effect as reflecting a reanalysis process.

D27

PROSODY AND RHYTHMIC REGULARITY DIFFERENTIALLY AFFECT CONTINUOUS SPEECH PROCESSING Ifedolapo Bamikole[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst — Previous event-related brain potential (ERP) studies indicate that listeners preferentially process the initial segments of words in continuous speech. Specifically, word onsets elicit a larger amplitude N1 after compared to before training on an artificial language. The current study explored the effects of lexical stress and rhythmic regularity on ability to learn words through exposure to continuous speech and on the modulation of early perceptually processing of word onsets. EEG was initially recorded while one group listened to six three-syllable words and another group heard two two-syllable, two three-syllable, and two four-syllable words. Both 'languages' were presented as continuous speech with the first syllable of each word 5 dB louder to indicate stress. After taking a behavioral test to assess word learning through mere exposure, participants were explicitly trained to recognize the items and then asked to listen to the continuous stream while EEG was recorded again. Participants who heard the nearly isochronous streams evidenced similar ERPs before and after training; those who heard the language with variable word length showed significant training effects. Specifically, word onsets elicited a larger amplitude N1 and N400 after compared to before training. These results suggest that rhythmic regularity marked by a strong prosodic cue is sufficient for listeners to both segment speech and preferentially process word onsets. Lexical familiarity is necessary to observe modulation of early perceptual processing of word onsets in the absence of nearly isochronous rhythms.

D28

WHAT'S THE STORY WITH THE PREFRONTAL CORTEX? HOW STORY SCHEMA INFLUENCES NARRATIVE COMPREHENSION: AN FMRI STUDY Michael Cannizzaro[1], Julie Dumas[1], Patricia Prelock[1], Paul Newhouse[1]; [1]University of Vermont — The clinical examination of discourse is a useful tool for studying communication skills in both children and adults with or without neurological impairments. The comprehension and production of discourse represents complex behavior in that integrated knowledge of linguistic principles, organizational structure, and pragmatic rules, are required to create a coherent message. Current neuroimaging data support the activation of a bilateral network (i.e., anterior prefrontal cortex, medial prefrontal cortex and the precuneus) involved in narrative discourse processing. However, it is not known how this network is influenced by the organizational structure of the story. Twelve right-handed native English speaking subjects (4 females), over the age of 18 (mean (SD) = 25.67 (2.5)), participated in this fMRI study. Structurally simple 60 word narratives containing a single complete episode were created to conform strictly to story grammar conventions (i.e., the schematic mental model). These were presented as either story narratives or unrelated sentences in a block design. Across all brain regions previously reported to be activated during narrative processing, we found reduced activation for cohesive schematically organized narratives compared to the unrelated sentences. This finding is consistent with structured event complex (SEC) knowledge framework (e.g., organizational rules and patterns related to mental schema) of the prefrontal cortex, at least in the case of linguistically based story narratives. In essence, the stimuli in the present study created a condition that reduced workload by the neural substrates previously associated with discourse processing, by using familiar organizational patterns based on theoretical mental schema.

D29

THE SOUND OF SILENCE: INVESTIGATING THE CONSEQUENCES OF DISFLUENT SILENT PAUSES IN SPEECH USING EVENT-RELATED POTENTIALS Lucy J. MacGregor[1], Martin Corley[2], David I. Donaldson[3]; [1]University of Leeds, [2]University of Edinburgh, [3]University of Stirling — Although little attention has been paid to them in the literature, silent pauses are a common form of disfluency in speech. Here we report an event-related potential (ERP) investigation into the consequences of such silences for listeners. Participants heard utterances ending in predictable or unpredictable words, some of which included a disfluent silence before the target. In common with previous findings using er disfluencies, the N400 difference between predictable and unpredictable words was attenuated for the utterances that included silent pauses. An earlier relative negativity, topographically distinct from the N400 effect and identifiable as a Phonological Mismatch Negativity (PMN), was found for fluent utterances only. This suggests that only in the fluent condition did participants perceive the phonology of unpredictable words to mismatch with their expectations. By contrast, for disfluent utterances only, unpredictable words gave rise to a late left frontal positivity, an effect previously observed following er and repetition disfluencies. We suggest that this effect reflects the engagement of working memory processes that occurs when fluent speech is resumed. Using a surprise recognition memory test, we also show that listeners were more likely to recognise words which had been encountered after silent pauses, demonstrating that silence affects not only the process of language comprehension but also its eventual outcome. We argue that from a listener's perspective, a critical feature of disfluency is the temporal delay which it adds to the speech signal.

D30

INDIVIDUAL DIFFERENCES IN COGNITIVE CONTROL PREDICT USE OF SEMANTIC AND SYNTACTIC INFORMATION Raechel Steckley[1], Kerry Ledoux[2], Tamara Y. Swaab[1,3]; [1]University of California, Davis, [2]Cognitive Neurology/Neuropsychology, Johns Hopkins University, [3]Center for Mind and Brain, University of California, Davis — This study examined if individual differences in cognitive control (measured by an AX-CPT task) influenced the interplay of semantic and structural factors during discourse processing. Participants read sentences in which implicit causality and discourse prominence were manipulated, e.g., 1) "…Robert amused Alison because Robert/Alison…", 2) "…Amy thanked Joe because Joe/Amy…". ERPs were measured to coreferentially repeated names that were consistent (Robert in (1); Joe in (2)) or inconsistent (Alison in (1); Amy in (2)) with the verb's bias, and that coreferred with a prominent (name in 1st NP) or non-prominent (name in 2nd NP) antecedent. A verb's implicit causality has been demonstrated to lead to immediate processing costs when a coreferential expression is inconsistent with the bias of the verb. Prominence of an antecedent (a structural factor of a sentence) influences processing of repeated name coreference: Names that corefer with a prominent antecedent are more difficult to process than names that corefer with a non-prominent antecedent. Low control subjects showed costs of violation of bias regardless of whether or not names coreferred with a prominent antecedent; inconsistent names elicited a greater N400 than consistent names. High Control subjects showed an interaction of consistency and prominence; processing costs were higher for consistent names that coreferred with a prominent antecedent, but for inconsistent names that coreferred with a non-prominent antecedent (greater P2 and P600). Thus, initial processing of the critical names was only influenced by semantic factors in low control subjects, but by both semantic and structural factors in high control subjects.

D31

AN ERP INVESTIGATION OF PHONOTACTIC CONSTRAINTS ON NATURAL RECEPTIVE LANGUAGE PROCESSING Erica Y. Shen[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst — Phonotactics define permissible sequences of adjacent sounds in a language. For example, in English, the morpheme "ed" on regular past-tense verbs and the morpheme "s" on regular plural nouns, have different phonological realizations depending on the last segment in the stem. Specifically, the appropriate consonant is voiced unless the stem-final phoneme is voiceless. The current study employed event-related brain potentials (ERPs) to investigate the effects of phonotactic constraints on natural receptive language processing. Participants were asked to listen to four short stories for comprehension. The stories included a small proportion of phonotactic violations introduced by replacing single phonemes in critical sentences with phonotactically legal (n=40) and illegal (n=40) sounds (e.g., 'cat-/s/' became 'cat-/s/' in the canonical version and 'cat-/z/' in the violation version). Simple subject-verb agreement violations were also included (e.g., 'the cat licks' vs. 'the cat lick') to provide a direct comparison between phonotactic and syntactic processing. Participants who were asked to press a button in response to any abnormalities in the sentences in a separate behavioral study detected the syntactic violations (d' = 2.7), but not the phonotactic violations (d' < 0.1). However, the phonotactic violations elicited an anterior positivity 30-180 ms after onset, suggesting that listeners have veridical representations of the phonotactically illegal strings early in processing. ERPs elicited by the phonotactic violations differed in polarity, latency, and distribution from the anterior negativity elicited by the syntactic violations, indicating that these two types of processing rely on distinct neural populations.

D32

ELECTROENCEPHALOGRAPHIC RESPONSES TO SMS SHORTCUTS Lesya Ganushchak[1], Andrea Krott[1], Antje S. Meyer[1]; [1]School of Psychology, University of Birmingham — As the popularity of sending messages electronically increases, so does the necessity of conveying messages more efficiently. One way of increasing efficiency is to abbreviate words and expressions by combining letters with numbers such as gr8 for "great", using acronyms such as lol for "laughing out loud", or clippings such as msg for "message". The present study compares the processing of shortcuts to the processing of closely matched pseudo-shortcuts. ERPs were recorded while participants were performing a lexical decision task. Response times showed that shortcuts were categorized more slowly as non-words than pseudo-shortcuts. The ERP results showed no differences between shortcuts and pseudo-shortcuts at time windows 50 – 150 ms and 150 – 270 ms, but there were significant differences between 270 – 500 ms. These results suggest that at early stages of word recognition, orthographic and phonological processing is similar for shortcuts and pseudo-shortcuts. However, at the time of lexical access the shortcuts diverge from pseudo-shortcuts, suggesting that shortcuts activate lexical representations.

D33

GENDER STEREOTYPES AND IMPLICIT VERB CAUSALITY IN LANGUAGE COMPREHENSION: AN FMRI STUDY Evelyn C. Ferstl[1], Christina Manouilidou[1,2], Alan Garnham[1]; [1]University of Sussex, UK, [2]University of Patras, Greece — In an fMRI study, we investigated pronoun resolution processes. Two distinct types biases were employed with the goal to disentangle lexical and pragmatic effects in text comprehension. Implicit causality refers to the fact that many verbs describing interpersonal events orient causal attribution. For example, the reason for the event "John frightened Mary" is likely to be something John has done. These verb biases are considered to be stored with the lexical entry of the verb. In contrast, gender stereotypes are at play in sentences like "Mark kissed the footballer because she was attractive" whose interpretation requires overriding the expectation that footballers are male. There is evidence that this type of information is not lexical but part of the readers' general world knowledge. The experiment had a 3 x 2 design, using neutral, consistent and inconsistent sentences for each of the two bias types. All sentences were plausible and contained an unambiguous pronoun referent. The sentences were visually presented in short phrases, and comprehension questions ensured the participants' attention. The results included a left dominant fronto-temporal network for the comparison of language trials against a non-word baseline, and the visual word form area, showing increased activation for the slightly longer gender stereotype sentences. There was no main effect of consistency. Significant interactions between consistency and bias type were found bilaterally in the dorsolateral prefrontal cortex and parietal areas, in the left superior temporal lobe, and in the precuneus. These results will be discussed in light of theories of language comprehension.

D34

WHEN PROSODIC PERCEPTION IS OVERRIDDEN: AN ERP STUDY OF THE COMPOUND/PHRASAL STRESS DISTINCTION IN ENGLISH Stewart McCauley[1], Arild Hestvik[1], Irene Vogel[1]; [1]University of Delaware — The present study examined listeners' ability to distinguish between compound and phrasal stress (e.g., hótdog vs. hot dóg) in English. Previous research using picture-word matching tasks has demonstrated a tendency to incorrectly interpret phrasally stressed strings as compounds (cf. Atkinson-King, 1973; Vogel & Raimy, 2002; Vogel et al., 2009). We used event-related potentials (ERPs) to investigate whether this pattern stems from poor perceptual sensitivity to the compound/phrasal stress distinction, or from post-perceptual bias in behavioral response selection (e.g., due to frequency, plausibility, or preference for analyzing strings as lexical items). 20 adults participated. Test items were pairs of segmentally identical phrases and compounds. In each trial, an image (e.g., a sweating canine) established context and was followed by a sentence including either the congruent or incongruent stress pattern (e.g., hótdog or hot dóg), resulting in a 2 (stress pattern) x 2 (congruency) within-subject design. Participants indicated whether the item depicted was named correctly. The behavioral results replicated previous findings of greater accuracy for compound stress. However, a right-anterior positivity was observed for both stress patterns when incongruent with the context, most likely in response to the prosodic expectancy violation (cf. Paulmann & Kotz, 2008). A left-anterior negativity (LAN) was observed for incongruent compound stress, whereas incongruent phrasal stress elicited a larger LAN followed by a P600-like posterior positivity. The LAN/P600 response may reflect the computation of unanticipated syntactic structure. The ERP results suggest that listeners are equally sensitive to both stress patterns but possess a strong post-perceptual bias for compounds.

D35

COMMON MECHANISMS UNDERLYING LEXICAL AND SYNTACTIC AMBIGUITY RESOLUTION Ranjani Prabhakaran[1], David J. M. Kraemer[1], John C. Trueswell[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania — Within the domain of language processing, an important unresolved question is whether lexical and syntactic ambiguities are resolved via similar mechanisms. Neuroimaging studies have implicated common regions of prefrontal cortex (PFC) as serving a critical role in resolving both of these types of linguistic ambiguities (e.g. Bedny, McGill, & Thompson-Schill, 2008; Mason et al., 2003). Additionally, constraint-satisfaction approaches to language processing suggest that similar mechanisms underlie the resolution of both lexical and syntactic ambiguities (e.g. MacDonald, Pearlmutter, & Seidenberg, 1994). However, the extent to which there is correlated variation in individuals' abilities to resolve lexical and syntactic ambiguities has not yet been investigated. In the current study, the same subjects were tested on separate syntactic and lexical ambiguity resolution tasks. In the lexical ambiguity resolution task, subjects made relatedness judgments for word pairs containing ambiguous words with multiple meanings (Bedny et al., 2008). In order to tap syntactic ambiguity resolution, subjects performed an eye-tracking visual world paradigm task (Farmer et al., 2007; Trueswell et al., 1999). In this task, subjects' eye movements were recorded as they carried out spoken instructions that contained a temporary syntactic ambiguity. A significant relationship was found between subjects' ability to resolve ambiguities across both tasks. In particular, those subjects who had more difficulty resolving lexical ambiguities also demonstrated greater difficulty in revising their initial interpretation of syntactically ambiguous sentences. These results support constraint-satisfaction models of language processing and suggest that similar processing mechanisms are employed to resolve both lexical and syntactic ambiguities.

D36

ACTIONS SPEAK LOUDER THAN WORDS: LOCATION WORDS MODULATE THE SPATIAL CHARACTERISTICS OF REACHING MOVEMENTS Ada Kritikos[1], Nerisa Dozo[1], Andrew Bayliss[1], David Painter[1]; [1]Psychology, University of Queensland — An intriguing speculation is that the language and motor systems are tightly interlinked. In particular, the conceptual knowledge about the real-world attributes of words is said to be "embodied" within the sensori-motor system (Gallese & Lakoff 2005). There is behavioural evidence for the impact of language on action, both in response times and in kinematic parameterisation: response times are slowed during concurrent action and articulation. Moreover, reading action words of the face, leg, or arm differentially activated areas along the motor strip that either were directly adjacent to or overlapped with areas activated by actual movement of that body part (Hauk et al 2004). We argue, however, that if sensori-motor concepts are embodied, the impact of language on action execution should be systematic, and specifically evident in spatial parameters: up-incongruent words should cause hand trajectories to be lower than up-congruent words. Using motion capture, we tested this idea by having participants reach and grasp the top or bottom of a vertical bar, while saying top- or bottom-congruent or incongruent action words. We recorded and analysed movement initiation time and the vertical trajectory deviation of the hand. Articulation of top-incongruent words was associated with a lower trajectory deviation than articulation of top-congruent. The same pattern in reverse was evident for bottom-congruent and –incongruent words. Response times, conversely, showed generalised disruption during concurrent articulation and action. We argue that spatial attributes of action are indeed embodied within language, and that this is most clearly measured with spatial parameters.

Perception & Action: Audition

D37

COORDINATING SPEECH AND TAPPING: EFFECTS OF RHYTHMIC STRUCTURE Pascale Lidji[1,2,3], Michele Morningstar[1], Isabelle Peretz[2], Caroline Palmer[1]; [1]Sequence Production Laboratory, McGill University, [2]Brams Laboratory, Université de Montréal, [3]Fonds National de la Recherche Scientifique, Brussels — We investigated whether linguistic rhythm influences listeners' sensorimotor synchronization of tapping with speech. Sensorimotor research in music has shown that listeners tend to synchronize better with temporally regular music than with expressive music, and that they tap slower to familiar musical styles than to unfamiliar music. Are sensorimotor integration patterns similar when participants coordinate their tapping with speech? We asked monolingual speakers of French and English to tap along to the subjective beat they perceived in French and English spoken sentences. English is generally classified as a stress-timed language, perceived in terms of stresses equally spaced in time, and French as a syllable-timed language (syllables are equally spaced in time). If participants' ability to tap in synchrony with speech is influenced by the rhythmic differences between languages, participants should tap more regularly with English than with French speech, irrespective of their native language. In addition, if, as in music, participants' linguistic expertise affects their sensitivity to hierarchical relationships, they should tap at a slower rate for sentences in their native language than in a foreign language. Preliminary results suggest that participants tend to tap at a slower rate to French than to English sentences, and that both groups of speakers tap less frequently to sentences in their native language. Further acoustical analyses of the stimuli will reveal what component of the French and English sentences (e.g. relative vowel duration, intonational phrase length) explains the effects of linguistic rhythm on speech synchronization.

D38

HOW IS PROSODIC PROCESSING LATERALIZED IN THE BRAIN? Jurriaan Witteman[1], Niels Schiller[1], Vincent Van Heuven[1]; [1]Leiden University — How suprasegmental (prosodic) information is processed in the brain is still a matter of debate. A central question within this discussion is to which extent prosodic processing is lateralized in the brain. There are three non-mutually exclusive hypotheses regarding lateralization of prosodic processing: (1) Acoustic lateralization hypotheses state that lateralization of prosodic processing is dependent on the acoustic nature of prosodic information (2) The functional lateralization hypothesis posits that it is the emotional versus linguistic function of prosodic material that drives lateralization (3) The attraction hypothesis extents the functional hypothesis by adding that the size of the prosodic unit is of importance To test the differential explanatory power of these three hypotheses, it is crucial that they are compared in one study. Therefore, in the present study two dichotic listening experiments were designed that systematically varied the function of prosodic material while keeping acoustics constant for different prosodic unit sizes. Through this design the three hypotheses of prosodic lateralization could be tested in one study. Results showed greater right hemispheric involvement for bigger prosodic units, in partial support of the attraction hypothesis. No evidence was found for acoustic or functional lateralization of prosodic processing. It is concluded that the idea of continuous close cooperation between the two hemispheres in the processing of prosodic information is supported. This is in keeping with the emerging picture from the recent literature, which suggests bi-hemispheric involvement in prosodic processing.

D39

IS THE REDUCED N1 TO SELF-GENERATED TONES AN EFFECT OF TEMPORAL PREDICTABILITY? Kathrin Lange[1]; [1]Heinrich Heine Universität Düsseldorf — Self-generated stimuli are processed differently from stimuli that are externally triggered. In the auditory event-related potential (ERP), this shows in an attenuated N1. There is, however, evidence that the auditory N1 is also reduced if the timing of the eliciting tone is predictable versus unpredictable. Since, typically, the timing of self-generated tones is more predictable than the timing of externally triggered tones, the present study investigated, whether the reduced N1 to self-generated tones can be explained by predictability alone. Participants listened to tones that were either externally triggered, self-generated by key-presses, or preceded by visual cues. In the generated and cued conditions, tones followed the key presses or cues, respectively, after a fixed (predictable timing) or variable delay (unpredictable timing). Consistent with the idea that the attenuation of the N1 is related to the temporal predictability of the stimulus, the auditory N1 was smallest in the self-generated predictable condition, next larger in the self-generated unpredictable condition, and largest in the externally triggered condition. Consistent with the idea that the attenuation of the N1 depends crucially on the involvement of the motor system, an enhancement rather than a reduction of the N1 was observed when temporal predictability was based on a predictive cue rather than on a motor act. These findings suggest that temporal predictability only has a modulating effect on the N1 attenuation observed for self-generated tones, whereas whether or not an attenuation is observed seems to depend crucially on how exactly predictability is achieved.

D40

DOES PHONOLOGICAL SHORT-TERM MEMORY CAPACITY CORRELATE WITH RHYTHMIC ABILITY? A BEHAVIOURAL AND FMRI STUDY OF INDIVIDUAL DIFFERENCES Jessica Grahn[1], Dirk Schuit[2]; [1]MRC Cognition and Brain Sciences Unit, Cambridge UK, [2]Maastricht University, The Netherlands — Rhythmic abilities vary widely in the general population, but little is known about the underlying causes of this variability. The current study examines how differences in phonological short-term memory (pSTM) and ability to detect beat structure correlate with individual differences in the ability to reproduce short, novel rhythms. Phonological STM was measured using digit span and pseudoword span tasks, in which participants heard short strings of digits or pseudowords and repeated them back verbally. Ability to detect beat structure was measured using the Beat Alignment Test (BAT), which requires participants determine whether beeps played along to musical stimuli are 'on the beat' or 'off the beat'. To measure rhythm reproduction, participants heard single presentations of rhythms that varied in length (~2-4.7 seconds), then tapped them back on a computer keyboard. Effects of musical training were covaried out of all analyses. Digit span and BAT score both significantly correlated with the percentage of accurately reproduced rhythms. Digit span and BAT score did not significantly correlate with each other, suggesting phonological short-term memory and ability to detect beat structure both relate to rhythmic ability, but independently from each other. Digit span, BAT, and rhythm reproduction scores were used as regressors in an fMRI study in which participants performed rhythmic and verbal auditory discrimination. Preliminary analysis indicates that activity during stimulus presentation was negatively correlated with digit span left posterior superior temporal gyrus. Positive correlations with BAT score were found bilaterally in the superior temporal sulcus.

D41

BEHAVIORAL AND NEURAL BASIS FOR AUDITORY-MOTOR INTERACTIONS IN MUSIC PERFORMANCE Rachel Brown[1], Joyce Chen[2], Avrum Hollinger[1], Virginia Penhune[3], Caroline Palmer[1], Robert Zatorre[1]; [1]McGill University, [2]Oxford University, [3]Concordia University — Speech and music performance rely on interactions between the auditory and motor systems to transform sounds into movements. Recent research suggests that distinct regions of the auditory-motor network, particularly the premotor cortex, may mediate different types of auditory-motor transformations. The ventral premotor cortex (vPMC) could mediate the direct mapping of specific sounds (e.g. musical pitches) to specific effector movements, while the dorsal premotor cortex (dPMC) may extract higher-order timing information from sounds to produce correctly-timed movements (indirect auditory-motor mapping). We tested the behavioral and neural dissociation between direct and indirect auditory-motor transformations in music performance using a repetition suppression paradigm. Trained pianists underwent fMRI scanning while they performed an auditory-motor mapping task. Pianists listened to musical sequences, which consisted of varying pitch and timing information, and subsequently played them back on an fMRI-compatible piano keyboard. We manipulated the repetition of pitch and timing information in the musical sequences across series of trials such that the pitch or timing information either repeated (remained constant) or did not repeat (changed). Pianists performed better on repeating versus changing pitch and timing elements. We predict that functional activation in the vPMC will selectively decrease in response to repeated pitch information and that activation in the dPMC will selectively decrease in response to repeated timing information. These predictions follow from the well-established finding that repeating events cause neural activity to decrease in neurons that process those events. The results will clarify how the auditory and motor systems integrate different types of information.

D42

AN ERP STUDY OF THE PERCEPTION OF MANDARIN TONES WITH TEMPORAL CUES: IMPLICATIONS FOR COCHLEAR IMPLANTS Yu-ching Kuo[1], Shih-kuen Cheng[2]; [1]Taipei Municipal University of Education, Taiwan, [2]National Central University, Taiwan — Event-related potentials (ERPs) were recorded while normal-hearing participants listened to cochlear implant simulations of different channel numbers, aiming to examine the relation between the number of channels in cochlear implants and the discrimination of lexical tones in Mandarin Chinese. Participants watched silent films while monosyllabic sounds of /yi/ in level and falling tones were played via loud speakers in different probabilities (level tone: 87.5%; falling tone: 12.5%). The mismatch negativity (MMN) component of auditory ERPs was used as an index of the discrimination between lexical tones under different channel numbers. The number of channels was manipulated across blocks. In one block, the speech sounds of /yi/ in level and falling tones recorded from a Mandarin Chinese speaker served as the stimuli. In the other blocks, the stimuli simulated the recorded sounds being transformed through 1-channel, 4- channel, and 8-channel cochlear implants, respectively. The MMN was observed in the speech sound condition: the waveforms elicited by the deviant stimuli were more negative than those elicited by the standard stimuli over frontal-central recording sites around 150-250 ms post stimulus onset. In the cochlear implant simulations, the MMN was observed in the 8-channel conditions but not in 1-channel and 4-channel conditions. The MMN elicited in the 8-channel condition was of smaller magnitude than that in the speech sound condition. These findings suggest that 8 channels in cochlear implants may provide sufficient information for the auditory system to differentiate between lexical tones in Mandarin Chinese.

D43

DOUBLE DISSOCIATION OF PITCH PRODUCTION AND PERCEPTION Sean Hutchins[1], Isabelle Peretz[1]; [1]International Laboratory for Brain, Music, and Sound Research (BRAMS), Université de Montréal — Dual-route models propose that sensory information is segregated into perception and action streams, and may account for the perception / action dissociations found, for example, in blindsight. Recent studies have shown similar dissociations in pitch perception and production (Hafke, 2008; Loui et al., 2008). In the current study, we focus on the pitch production and perception abilities of one congenital amusic participant, ML, who shows very good pitch production abilities despite her severe pitch perception deficit. We directly compare vocal pitch matching abilities to pitch perception abilities using a novel instrument-based pitch matching task. This instrument is touch sensitive, requires no musical experience, and can produce a continuous set of pitches. Unlike singing, it should not be reliant on pathways directly linking musical pitch perception and action. ML and a set of non-musicians used this instrument and their voices to match musical pitches presented to them. Non-musicians showed very good instrumental pitch matching, but a range of abilities in vocal pitch matching. In contrast, ML was very impaired in instrumental pitch matching, but was very accurate at vocal pitch matching. These results indicate a double dissociation between vocal pitch matching, a natural form of pitch production which utilizes action pathways, and instrumental pitch matching, which utilizes perception pathways for its comparisons. This double dissociation provides further support for a dual route model of pitch production and perception that may correspond to the operation of the dorsal and ventral neural pathways that relate the auditory and inferior frontal cortex, respectively.

D45

HIERARCHICAL RHYTHM PERCEPTION IN ACOUSTIC SIGNALS – AN FMRI STUDY Eveline Geiser[1], Elsa Sägesser[2], Martin Meyer[2], John Gabrieli[1], Lutz Jäncke[2]; [1]Massachusetts Institute of Technology, [2]University of Zurich, Switzerland — The perception of timing is immanent in all sensory domains. One of the most basic timing perception capacities is the distinction between temporally regular and irregular signals. Recent neuroimaging evidence suggests that the basal ganglia, supplementary motor gyrus (SMA), and superior temporal gyrus are involved in attentional timing perception. The specific function of these brain areas for timing perception remains unclear. The present functional magnetic resonance imaging (fMRI) experiment was aimed at investigating the perception of temporal regularity in auditory signals in an implicit (unattentional) processing task. Participants listened to tonal sequences consisting of regular (metrical) rhythms and to tonal sequences without a regular rhythm (control condition). We manipulated the strength of the perceived regularity in different rhythm conditions by adding an increasing number of temporal subdivisions to the basic beat structure. This resulted in a parametric increase of 'metrical hierarchies' between regular rhythm conditions. The subjects had to identify different pitch changes within these tonal stimuli. Results revealed that the basal ganglia (putamen) are stronger activated in the processing of regular as compared to irregular rhythms. Interestingly, activity in SMA increased with stronger regularity perception. These findings suggest that BG and SMA serve complementary roles in the perception of auditory regularity.

D46

MATURATION OF AUDITORY CORTEX THROUGH ADOLESCENCE AND ITS RELATIONSHIP TO DETECTION OF 2-HZ FREQUENCY MODULATION Mary Elizabeth Sutherland[1,2], Robert Zatorre[1,2], Pierre-Yves Hervé[3], Kristina Martinu[1], Gabriel Leonard[1], Kate Watkins[4], Tomas Paus[1,3]; [1]Montréal Neurological Institute, McGill University, [2]BRAMS Laboratory, [3]Brain and Body Centre, University of Nottingham, UK, [4]University of Oxford — Adults show great variation in their aptitude for different auditory tasks, such as discriminating between foreign speech-sounds. Previous research has demonstrated that structural features of auditory cortex can predict auditory abilities; we are interested in the maturation 2-Hz frequency-modulation

(FM) detection, a task thought to tap into mechanisms underlying language ability. We hypothesized that an individual's FM threshold will correlate with greater grey-matter density in left Heschl's gyrus (HG), and that this correlation will change through adolescence. To test this hypothesis, we collected anatomical magnetic resonance imaging data from participants who were tested and scanned at three time points: at 10, 11.5 and 13 years of age (n=~45). Participants judged which of two tones contained FM; their threshold was calculated based on the geometric mean of several trials. Using voxel-based morphometry, we found that FM threshold was significantly correlated with grey matter in left HG pre-puberty (lower thresholds were associated with greater concentration of grey matter); this correlation weakened after the onset of puberty (ages 11 and 13). Our results confirm that the structure of the auditory cortex can predict temporal processing abilities, in particular that grey-matter density in left HG can predict 2-Hz FM detection threshold. This ability is dependent on the processing of rapidly changing sounds, a skill believed necessary for speech processing. The weaker correlation between these regions and 2-Hz FM processing at age 11.5 and 13 may indicate the effect of maturational processes that occur during adolescence on this particular brain-behaviour relationship.

D47

CATEGORY SPECIFICITIES IN THE NEURAL PROCESSING OF ENVIRONMENTAL SOUNDS: ACTIVATION-BASED MAPPING Bruno Giordano[1], Stephen McAdams[1], Robert Zatorre[2,3,4], Niko Kriegeskorte[5], Pascal Belin[4,2]; [1]CIRMMT - Schulich School of Music, McGill University, [2]BRAMS Laboratories, Universite de Montréal & McGill University, [3]Montréal Neurological Institute, McGill University, [4]Centre for Cognitive Neuroimaging, University of Glasgow, [5]MRC-CBU, Cambridge — Two drawbacks are common among previous studies on the category-specific processing for environmental sounds. Firstly, subjective choices are made relative to the reference categories against which a specificity is assessed (e.g., nonliving action sounds contrasted against living vocal sounds but not nonliving nonaction sounds). Secondly, potential confounds are seldom controlled (e.g., low-level factors such as stimulus duration or higher-level factors like semantic heterogeneity). We addressed these issues in a study on 32 3-sec highly heterogeneous environmental sounds. Stimuli spanned several different categories: living vs. nonliving; human vs. nonhuman; vocal vs. nonvocal; action vs. nonaction. Categories were equalized in sound duration and level, identifiability and semantic heterogeneity. In an event-related design, 20 right-handed, normal-hearing participants responded to rare subsequent repetitions of a stimulus randomly selected from the set. Functional scans (2X2X2.75 mm) were acquired at 3T. Contrasts were carried out within a group-level random-effects model. As expected, all sounds activated bilaterally the auditory cortices. Strong category-specificities for human and nonhuman vocal sounds emerged in the right TVA and in the left STG, independently of the reference category. Additional significant category specificities appeared to be driven by the vocal vs. nonvocal distinction (e.g., living vs. nonliving). All of the contrasts that did not include vocal sounds were nonsignificant (e.g., nonliving action sounds vs. nonliving nonaction sounds such as thunder). We speculate that the cortical discrimination of vocal and nonvocal sounds is far more robust than that for any other category of environmental sounds.

D48

CATEGORY-SPECIFICITIES IN THE NEURAL PROCESSING OF ENVIRONMENTAL SOUNDS: INFORMATION-BASED MAPPING Pascal Belin[1,2], Bruno Giordano[3], Stephen McAdams[3], Niko Kriegeskorte[4], Robert Zatorre[2,5]; [1]Centre for Cognitive Neuroimaging, University of Glasgow, [2]BRAMS Laboratories, Universite de Montréal & McGill University, [3]Schulich School of Music, McGill University, [4]MRC-CBU, Cambridge, [5]Montréal Neurological Institute, McGill University — In a companion poster, we investigated the activation-based mapping of a set of 32 heterogeneous environmental sounds. Here we tested for category-specificities within the framework of Representational Similarity Analysis (RSA, Kriegeskorte et al. (2009) Frontiers in Systems Neuroscience). This multivariate statistics approach has the potential to reveal category specificities unconstrained by prior assumptions, and to relate the pattern of neural activity to acoustical and behavioural data for these sound stimuli 20 subjects were scanned with 3T fMRI in two functional runs: i) a 10-min functional localizer of the temporal voice areas (TVA) (cf. http://vnl.psy.gla.ac.uk) contrasting vocal vs. non-vocal sounds to individually localize primary auditory cortex (A1) and the TVA; ii) a 40-min scan during which each of 32 3-sec long auditory stimuli were presented 16 times each in a pseudo-random order, while subjects were performing a 1-back task. Analyses were performed using SPM8 and ad-hoc matlab scripts. After scanning, subjects rated all possible pairs of stimuli on their perceived dissimilarity. A group-level random-effects map was generated for each of the 32 sound stimuli. These were used to build neural representational dissimilarity matrices (RDM) at different stages of the cortical processing architecture: 4 locations of auditory cortex: left and right A1, and left and right TVA. These neural RDMs are in turn related to corresponding acoustical and behavioural RDMs. Preliminary results indicate that multivariate patterns of response to the 32 stimuli in A1 contain information sufficient to discriminate living vs. non-living sounds, although the univariate-level response is not different.

D49

"VIRTUAL LESION" OF THE LEFT VENTRAL PREMOTOR CORTEX DISRUPTS PREFERENCE FOR MUSICAL BEAT RATE Katja Kornysheva[1], Anne-Marike Schiffer[1], Ricarda I. Schubotz[1]; [1]Max Planck Institute for Neurological Research — Although a universal human behavior, from a neuroscientific perspective, it remains unclear why people often feel the urge to move their body or hum to a musical beat. A preceding functional magnetic resonance imaging (fMRI) study (Kornysheva et al. 2009) revealed an activity boost in the left ventral premotor cortex (PMv), particularly, when subjects listened to rhythms with a preferred beat rate (tempo) – a principal cue when it comes to synchronizing body movements to music. Left PMv activity positively correlated with how strongly the subjects preferred a particular tempo. However, it remained uncertain whether left PMv activity is causally relevant for tempo preference strength. To directly address this question, we conducted an offline repetitive transcranial magnetic stimulation (rTMS) study with a new group of subjects. 0.9 Hz rTMS (900 pulses) was applied over the left ventral premotor cortex and a control site to temporarily disrupt activity in the stimulated areas. Results demonstrate that activity in the left PMv determines the strength of tempo preference. This effect was specific to the preference for tempo and could not be explained by a general impairment of tempo recognition. To our knowledge, this is the first study to provide evidence for the influence of neural activity on musical tempo preferences. We suggest that the left PMv, being a node of audiomotor integration, drives the urge to move or hum to a musical beat.

D50

CEREBRAL ACTIVITY IN THE TEMPORAL VOICE AREAS (TVA) PREDICTS MEMORY FOR VOICES Rebecca Watson[1], Frances Crabbe[1], Ileana Quinones[2], Ian Charest[1], Patricia Bestelmeyer[1], Marianne Latinus[1], Pascal Belin[1]; [1]Centre for Cognitive Neuroimaging, University of Glasgow, United Kingdom, [2]Cuban Neuroscience Centre, Havana, Cuba — BACKGROUND: The Temporal Voice Areas (TVA) of the auditory cortex are known to respond selectively to human voices, but their relation to voice perception remains unclear. Here we investigate the relation between cerebral activity in the TVA and performance at voice perception tasks. METHOD: 36 participants were subjected to the Voice Perception Assessment (VPA), a short battery of voice and auditory perception tasks, and were scanned in a 10-min TVA functional localiser on a 3T Siemens Trio fMRI scanner. TVA localiser scans were analysed using SPM5, and the related scores of the participants included as separate covariates. The VPA and TVA localiser are available at: http://vnl.psy.gla.ac.uk. RESULTS: We found a highly significant correlation between TVA response to sounds (both vocal and non-vocal) and immediate recall performance for the voice memory subtest of the VPA (global maximum: T34 = 3.97, $p < 0.0001$ (uncorr.)). Notably, the relation between auditory cortical activity and performance at a control task – memory for bells—was much less significant (global maxima: T34 = 2.46, $p < 0.02$ (uncorr.). Additionally, this region was outwith the TVA. CONCLUSION: Results indicate that inter-individual variation in TVA activity explains a significant proportion of the variance in voice memory performance. They have strong implications for the functional role of the TVA.

D51

MUSICAL TRAINING ENHANCES IMPLICIT LEARNING OF COMPLEX TONE PATTERNS – AN MEG STUDY Sibylle C. Herholz[1], Bastiaan Boh[1], Claudia Lappe[1], Christo Pantev[1]; [1]Institute for Biomagnetism and Biosignalanalysis, University of Muenster, Germany — The separation of meaningful sound patterns from random noise in the acoustical environment is an important aspect of auditory processing. The aim of the present studies was to investigate the effect of long-term musical training on the encoding of higher-order regularities within short-term auditory memory from a global context within human auditory cortex. By means of magnetoencephalography (MEG) activity within auditory cortex was recorded in two studies using auditory oddball paradigms. Mismatch negativity (MMN) responses to violations of a predominant sequential tone pattern, which indicate that the pattern was encoded in auditory short-term memory, as well as the development of the pattern MMN over time were compared between musicians and nonmusicians. Despite the relatively low probability of the pattern within the stimulation sequence, violations of the pattern elicited a pattern MMN response in both groups. This response was stronger and more left-lateralized in musicians compared to nonmusicians. Only in musicians a constant increase of the pattern MMN amplitude was observed over the course of the measurement session. The findings indicate that higher-order regularities contained in tone sequences are encoded in auditory cortex on a very early level of processing, based on probabilistic information extracted from the global context. The observed leftward lateralization of the effect in musicians might be a result of cortical reorganization due to their long-term musical training. The amplitude increase over time indicates an increasingly stable neuronal representation of the regularity and enhanced implicit short-term learning in musicians.

D52

MAPPING PERIODICITY IN HUMAN AUDITORY CORTEX USING REPEATED FROZEN NOISE Paul Fillmore[1], I-Hui Hsieh[2], L. Tugan Muftuler[1], Kourosh Saberi[1], Gregory Hickok[1]; [1]University of California, Irvine, [2]National Central University, Taiwan — Generally, the fundamental organization of the auditory system is thought to be centered around the principle of tonotopy, or place mapping based on sound frequency. However, since frequency cannot be represented without a period of time over which to integrate it, time must also be a fundamental factor in sound organization. Indeed, animal work has demonstrated duration tuning, and has suggested a periodotopic organization orthogonal to tonotopy. Though many studies have examined temporal organization in the human auditory system, a primary focus has been on differences between the two cerebral hemispheres, and less is known about general organization within-hemisphere. To this end, we conducted an fMRI study using repeated frozen, or periodic, noise, covering timescales from 2.5 – 40 Hz (25, 50, 100, 200 and 400 ms repeat durations) to investigate the neural regions involved in periodicity coding within each hemisphere. Though each duration activated primary auditory cortex well, each had differing regions of maximal activation throughout the temporal plane. Additionally, we found regions in the superior temporal gyrus bilaterally, just anterior to primary auditory cortex, which responded linearly to increasing period duration.

D53

SPECTRAL FEATURES OF SPEECH DRIVE THE INDUCED EEG BRAIN RESPONSE: PARAMETRIC CHANGES IN ALPHA- AND THETA-BAND POWER Jonas Obleser[1], Nathan Weisz[2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]University of Konstanz, Konstanz, Germany — This study investigates the oscillatory brain dynamics in human EEG in response to acoustic features of speech. We specifically hypothesized that an event-related suppression of alpha power should reflect the effortful yet successful comprehension under adverse listening conditions. Spectral and temporal features of acoustically degraded words were parametrically varied. We analysed evoked and induced (non-phase-locked) EEG responses in 24 healthy German participants, who listened and rated comprehensibility after each trial. Trials were grouped according to spectral detail (2-, 4-, 8-, 16-band vocoding) or temporal detail (2-, 4-, 8-, 16-Hz lowpass filtering of the vocoding envelopes). Parametric t-statistics were run on wavelet transforms, flanked by conventional evoked potential analyses. Rating scores and EEG measures confirmed the predominance of spectral detail in comprehension. The evoked N100 amplitude to word onsets showed a linear increase with less spectral detail (i.e., decreasing intelligibility). In turn, a permutation test for time-frequency-electrode clusters in the induced brain oscillations revealed a circumscribed left-posterior theta (4--6 Hz) enhancement, showing a linear increase of theta power with increasing intelligibility. This was followed by a first left-lateralized, then broadening cluster of alpha suppression (8--13 Hz) from 600--900 ms after word onset: Alpha power appeared linearly suppressed for more spectral detail in a trial, and hence a more likely success of comprehension. Results tie suppression of alpha as well as brief increases of left-scalp theta activity to speech intelligibility and offer a new link between speech perception mechanisms and oscillatory brain dynamics.

D54

CONGENITAL AMUSIA : PERCEPTION WITHOUT AWARENESS FOR SMALL PITCH DIFFERENCES Patricia Moreau[1], Pierre Jolicoeur[1], Isabelle Peretz[1]; [1]BRAMS, CERNEC, Université de Montréal — Congenital amusia is a lifelong disorder characterised by a difficulty in appreciating and producing music despite normal intelligence and hearing. Behavioral data have indicated that congenital amusia originates from a deficit in fine-grained pitch discrimination. A recent electrophysiology study has demonstrated that this deficit can be traced to an abnormal right-lateralised N2-P3 brain response for pitch differences smaller than a semitone. However, a recent electrophysiological study indicates that the amusic brain can detect quarter-tone changes in melodies without awareness, by exhibiting a normal mismatch negativity (MMN) brain response. Here, we re-examine the event-related MMN and P3 components in an acoustical context to investigate further the pitch discrimination deficit underlying congenital amusia. In two separate recording periods, we measured the MMN and the P3 to tones that deviated by a quartertone and a whole tone from a repeated standard tone. The results show a normal MMN but no P3 for the small pitch differences. These results indicate that the amusic brain responds to small pitch differences at a preattentive level of processing, revealed by a normal MMN, but is unable to detect those same pitch differences consciously at a later attentive level of processing, inferred from the absence of the P3. The results are consistent with the idea that the auditory cortex of amusic individuals is functioning normally and that their music perception deficit results from an abnormal connectivity with the inferior frontal cortex.

D55

NEURAL SYNCHRONIZATION AND STOCHASTIC RESONANCE IN THE 40-HZ TRANSIENT RESPONSE Lawrence Ward[1], Shannon Maclean[1], Hiroshi Ueda[1], Keiichi Kitajo[2], Aaron Kirschner[1], Nicolas Thorne[1]; [1]University of British Columbia, [2]Riken Brain Science Institute — Neural synchronization is a mechanism whereby functionally specific brain regions establish transient networks for perception, cognition, and action. Direct addition of weak noise (fast random fluctuations) to various neural systems enhances synchronization through the mechanism of stochastic resonance (SR). Moreover, SR also occurs in human perception, cognition, and action. We speculated that SR-mediated neural synchronization in auditory and other areas is responsible for behavioural SR. To test this we measured the 40-Hz transient response of the human auditory cortex to brief pure tones. This response arises when the ongoing, random-phase, 40-Hz activity of a group of tuned neurons in the auditory cortex becomes synchronized in response to the onset of an above-threshold sound at their "preferred" frequency. We presented a stream of near-threshold standard sounds (5 dB SL at 500 or 1000 Hz) in various levels of added broad-band noise (zero, and -5 dB SL to 20 dB SL) and measured subjects' 40-Hz response to the standards in a deviant-detection (deviants 20 dB SL) paradigm using high-density EEG. We used independent component analysis and dipole fitting (EEGLAB) to locate neural sources of the 40-Hz response in both auditory cortices, left posterior cingulate, and left orbitofrontal cortex. We found in all of these areas an enhanced 40-Hz response at low levels of added auditory noise, thus demonstrating behaviourally-relevant neural SR. Moreover, long-distance synchronization between pairs of these regions increased both during and after the 40-Hz response for the same noise levels, implying that SR facilitates formation of networks of brain regions.

D56

COMMON IPS ACTIVATION FOR TWO TYPES OF MENTAL MUSICAL TRANSFORMATION Nicholas E. V. Foster[1,2], Andrea R. Halpern[3], Robert J. Zatorre[1,2]; [1]Montréal Neurological Institute, McGill University, [2]International Laboratory for Brain, Music, and Sound Research (BRAMS), [3]Bucknell University — Visuospatial transformation tasks like mental rotation are associated with BOLD activation in the anterior intraparietal sulcus (IPS). In previous studies in separate groups, we found similar IPS activity during two mental musical transformation tasks: temporal reversal and transposition from one pitch level to another. These two transformations are quite different, but we hypothesized that they may rely on a common IPS mechanism for systematic transformation from one reference frame to another. In this experiment we sought to determine whether both of these auditory transformations recruit overlapping subregions of IPS in individual subjects. Twelve highly trained musicians underwent fMRI while performing same/different judgments on short melody pairs, where the second melody was either untransformed, reversed in time or transposed in pitch. We performed a per-subject conjunction analysis on the contrasts (reversed - untransformed) and (transposed - untransformed) and found common bilateral activation in anterior IPS. This finding supports the hypothesis that the IPS performs transformations in both time and frequency, the two parameters upon which auditory processing depends. We were also interested in the behavioral correlates of transposition magnitude, since in visuospatial rotation tasks, correlations between rotation magnitude and accuracy have been observed. We predicted that greater transposition distance would be associated with elevated error rates, and that the musical key distance (i.e. number of shared pitches between the original and transposed key) would have more influence than the pitch interval distance. We found that the key distance was indeed more predictive of behavior, except for the smallest pitch distance (1-semitone).

D57

WHY MUSIC MOVES US: PARALLEL MOTOR NETWORKS IN ? AND HIGH-? NEUROMAGNETIC OSCILLATION ACTIVATED ACCORDING TO THE TEMPO OF REGULARLY REPEATING SOUNDS Takako Fujioka[1,2], Laurel Trainor[2,1], Edward Large[3], Bernhard Ross[1]; [1]Rotman Research Institute, University of Toronto, [2]McMaster University, [3]Florida Atlantic University — Moving in synchrony with music or a periodic rhythm as in dancing is easy for most people, even in those with Parkinson's Disease patients, although the underlying mechanism is not well understood. Based on hypotheses about movement-related neural oscillations, we examined beta- (13-25Hz) and high-gamma-band (70-90Hz) activity in magnetoencephalography (MEG) recorded from healthy young adults during passive listening to isochronous tones with an inter-onset interval of either 390, 585 or 780 ms. The non-phase-locked beta power in auditory and motor-related cortices decreased after each tone, followed by an increase, replicating each stimulus rate. A brief burst of phase-locked high-gamma activity was found 36 ms after stimulus onset in all conditions in thalamus, hippocampus, auditory cortex and anterior cingulate. We propose that two parallel basal-ganglia-thalamo-cortical loops for beta and high-gamma oscillations are involved in auditory-motor synchronization, such that the beta-high-gamma interaction facilitates precise timing encoding and predictive movement initiation.

D58

CONGENITAL AMUSIA IN CHILDHOOD: A CASE STUDY Marie-Andrée Lebrun[1,2], Patricia Moreau[1,2], Andréane McNally-Gagnon[1,2], Geneviève Mignault Goulet[1,2], Isabelle Peretz[1,2]; [1]University of Montréal, [2]The International Laboratory for BRAin Music and Sound (BRAMS) — Congenital amusia is a developmental disorder characterized by impaired pitch perception that compromises music perception and production. This disorder has been documented in the adult population only. Here, we report the first documented case of congenital amusia in childhood. AS is a ten-year-old girl who was referred to us by her choir director for persisting difficulties in singing. We tested her with a new version of the Montreal Battery for the Evaluation of Amusia (MBEA) for children that confirmed AS's severe problems in discrimination and memory of melodies. She cannot detect pitch changes that are smaller than a quarter of a semitone, whereas a majority of children of her age can. This pitch disorder may account for the fact that AS sings out of tune but relatively in time. AS's attentional and intellectual functions are normal. Thus, AS represents a clear case of musical disorders in childhood that cannot be explained by peripheral hearing loss, lack of exposure, or intellectual deficiency.

D59

2D:4D DIGIT RATIO FAILS TO PREDICT COGNITIVE ABILITY IN FOUR DOMAINS Mark Schmidt[1], Tiffany Livingston[1], Amanda Gesselman[1], Cassandra Hranek[1]; [1]Columbus State University — The length ratio of the 2nd and 4th digits (2D:4D) is sexually dimorphic, with males having a smaller ratio than females. The dimorphism is believed to be induced by prenatal testosterone exposure, and has been popularized as an indicator of performance in a variety of areas including sports, financial trading, and cognitive ability. It has been linked to cognitive sex differences in some studies. Males typically outperform females in tests of right hemispheric function (e.g., mental rotation) while females typically outperform males in tests of left hemispheric function (e.g., verbal fluency). It has been suggested that testosterone exposure in utero slows development of the left hemisphere, resulting in a more highly developed right hemisphere. The goal of the present study was to further investigate the putative relationship between the 2D:4D ratio and sex-linked cognitive abilities. Digit ratios were correlated with performance on mental rotation, verbal fluency, and spatial memory tasks (N = 85) and a numerosity perception task (N = 30). As expected, males had a significantly smaller 2D:4D ratio than females. However, 2D:4D did not predict performance in either verbal fluency, visual spatial memory, or numerosity perception. Digit ratio did predict performance in mental rotation, but the correlation was positive, with lower digit ratios associated with lower mental rotation scores. These results suggest that 2D:4D is not a reliable predictor of cognitive ability in tasks where sex-differences are typically found, nor in numerosity perception, an ability in which sex differences have not previously been documented.

D60

NEURAL ACTIVITY LOCALIZATION BY PREDICTIVE MAPPING BETWEEN IMAGING MODALITIES Yaroslav Halchenko[1], Michael Hanke[1], James Haxby[1], Stephen Hanson[2], Christoph Herrmann[3]; [1]Dartmouth College, [2]Rutgers University, [3]University of Magdeburg — There is growing interest in combining signals from multiple neuroimaging data modalities -- often with the primary goal of achieving superior temporal and spatial resolution. Here we show that an analysis of data from multiple imaging modalities also offers a way to segregate neural information from physiological and acquisition noise. Given the notion that both modalities reflect the same underlying neural signal, we are suggesting a novel methodology to reliably localize brain areas engaged in neural processing, by constructing a predictive mapping of data from one modality (electroencephalography, EEG) into the other (functional magnetic resonance imaging, fMRI). Neural activity is localized where a significant proportion of the fMRI signal can be reliably reconstructed (assessed via cross-validation) solely from simultaneously recorded EEG data, hence the signal appears to be common to both imaging modalities. We validate this method on artificial and real data from an auditory experiment. We show that areas engaged in the auditory tasks extend beyond brain activity foci detected with unimodal model-driven approaches such as general linear model (GLM). Moreover, a sensitivity analysis of the cross-modal mapping allowed us to associate particular brain areas with certain features of EEG signal (e.g. alpha-rhythm). The mapping neither relies on an explicit specification of experimental conditions, nor does it impose strict EEG/fMRI modeling assumptions. Thus we suspect that our approach is especially suitable for the analysis of experiments with loose designs (e.g. resting state studies). Furthermore, the predictive mapping can also be used for EEG-guided temporal upsampling and filtering of fMRI.

D61

ELECTRICAL BRAIN RESPONSES TO PITCH CHANGES IN CHILDREN WITH CONGENITAL AMUSIA Geneviève Mignault[1], Patricia Moreau[1], Isabelle Peretz[1]; [1]BRAMS, University of Montréal — Congenital amusia is a disorder that affects mainly the processing of pitch, preventing individuals from developing basic musical skills. It has been shown that this disorder can be traced down to an abnormal right-lateralized N2-P3 brain response elicited by pitch changes smaller than a semitone. However, it has also been demonstrated that the amusic brain processes these same pitch differences accurately at a preconscious level, as reflected by the event-related mismatch negativity (MMN). These results, obtained with adult amusics, suggest that the pitch deficit found in congenital amusia may not originate from a neural anomaly in the auditory cortex but rather later, along the temporo-frontal auditory pathway. The brain responses to pitch changes in congenital amusia have not yet been studied in children. In this study, we examined the brain responses to pitch in amusic children. First, we examined these responses at a pre-conscious level, with a MMN paradigm. We further examined the conscious detection of pitch changes with an oddball task paradigm. We compared 8 amusic children with 10 normal children. The results reveal a pattern of electrical brain responses that is comparable to the one obtained in adult amusics. That is, we found an abnormal right-lateralized P3 elicited by pitch changes smaller than a semitone, but a normal mismatch negativity for the same pitch changes. This indicates that the neurofunctional origins of the pitch deficit found in congenital amusia in children are similar to those observed later in life, at the adult age.

D62

FUNCTIONAL MRI AND PSYCHOPHYSICAL INVESTIGATIONS OF FREQUENCY-MODULATION SELECTIVITY IN HUMAN AUDITORY CORTEX I-Hui Hsieh[1], Paul Fillmore[2], L. Tugan Muftuler[2], Gregory Hickok[2], Kourosh Saberi[2]; [1]National Central University-Taiwan, [2]University of California-Irvine — Evidence from animal neurophysiology and human psychophysics suggest that the primate cortical auditory system is well equipped for identifying the direction of frequency-modulated (FM) sweeps, a critical acoustic component of speech and other conspecific communication signals. Though the notion that there exist specialized populations of FM direction-sensitive neurons in the human cortex is highly plausible, no direct neuroimaging or psychophysical evidence of such populations exists. We investigated the ability of the auditory system to selectively code FM sweep direction in both psychophysical and fMRI experiments. Among our psychophysical findings were counterintuitive reversals in sound-source localization induced by reversing the FM sweep direction (up or down in frequency). These reversals were uniquely associated with FM sweeps, directly dependent on sweep direction, and not observed with spectrally stationary stimuli. These findings were complemented with an fMRI experiment that used multivariate pattern analysis to assess whether neurons in the human auditory cortex can discriminate upward from downward frequency sweeps. Stimuli were brief (e.g., 100 ms) multitone logarithmic FM sweeps consisting of a 5-tone complex with 1/3 octave spacing. In a sparse-sampling procedure, speakers of Mandarin Chinese determined the direction of successive presentations of FM sweep complexes in a random-block design. Substantial activation was observed in primary auditory cortex, as well as differing levels of maximum activity in several other core auditory regions including the superior temporal gyrus, superior temporal sulcus, and sylvian fissure. Findings have implications for speech encoding and lexical distinction in tonal-language processing.

D63

AUDITORY AND COGNITIVE DEFICITS ASSOCIATED WITH ACQUIRED AMUSIA AFTER STROKE: A MAGNETOENCEPHALOGRAPHY AND NEUROPSYCHOLOGICAL FOLLOW-UP STUDY Teppo Särkämö[1,2], Mari Tervaniemi[1,2], Elina Pihko[3,4]; [1]Cognitive Brain Research Unit, University of Helsinki, Finland, [2]Finnish Centre of Excellence in Interdisciplinary Music Research, University of Jyväskylä, Finland, [3]BioMag Laboratory, Helsinki University Central Hospital, Finland, [4]Low Temperature Laboratory, Helsinki University of Technology, Finland — Acquired amusia is a common disorder after damage to the middle cerebral artery (MCA) territory. However, its neural mechanisms, especially the relative contribution of perceptual and cognitive factors, are still unclear. We studied auditory and cognitive processing in the amusic brain by performing magnetoencephalography (MEG) measurements of neural sound discrimination, indexed by the magnetic mismatch negativity (MMNm) response to frequency and duration changes, and neuropsychological testing in 53 patients with a left (n = 24) or right (n = 29) hemisphere MCA stroke 1 week, 3 months, and 6 months after the stroke. Amusia was evaluated using the Montreal Battery of Evaluation of Amusia (MBEA). We found that amusia caused by right hemisphere damage (RHD), especially to temporal and frontal areas, was more severe than amusia caused by left hemisphere damage (LHD). Correlation analysis also showed that the severity of amusia was related to weaker MMNm responses only in amusic RHD patients. Within the RHD subgroup, the amusic patients who had damage to the auditory cortex (AC) showed worse recovery on the MBEA as well as weaker MMNm responses than non-amusic patients or amusic patients without AC damage throughout the 6-month follow-up. In contrast, amusic patients both with and without AC damage performed worse than non-amusic patients on tests of working memory, cognitive flexibility, and attention throughout the follow-up period. These findings suggest domain-general cognitive deficits to be the primary mechanism underlying amusia without AC damage whereas amusia with AC damage is associated with both auditory and cognitive deficits.

D64

DEVELOPMENT OF CORTICAL REPRESENTATIONS FOR SOUND LOCATION IN INFANCY Laurel Trainor[1], Ranil Sonnadara[1,2], Kristin Tonus[1]; [1]McMaster University, [2]University of Toronto — The ability to localize sounds enables us to locate objects in space, and also helps us identify objects through creating separate representations for simultaneously-sounding objects. We have shown that in adults event-related potential responses derived from EEG recordings to a change in sound location as measured by the mismatch negativity (MMN) component occur earlier than for changes in other sound features such as pitch and duration (Sonnadara et al., 2006). Thus, one might predict early developmental emergence of MMN for changes in sound location. We presented 5- 8- and 12-month-old infants with a frozen burst of white noise (200 ms) from in front (80% of 2400 trials) and from 90o to the right and left (10% each). In previous work we have shown that mismatch responses to pitch changes shift between 3 and 6 months of age from an increase in a slow positive wave (not present in adults) to an adult-like negative wave (He et al., 2007, 2009). If this shift reflects the general maturation of auditory cortex, responses to changes in sound location should follow the same developmental trajectory. Contrary to expectations, we measured a significant immature positive mismatch response and no adult-like MMN at any of the ages tested. We conclude that sound localization mechanisms remain immature past 12 months. Perhaps it is advantageous to maintain immaturity while interaural time and intensity cues to location change dramatically as head size increases rapidly over the first year after birth.

D65

CONFUSING YOUR MOTHER FOR A HORSE? AN ERP INVESTIGATION OF PURE TONE PITCH DISCRIMINATION IN NATIVE SPEAKERS AND SECOND LANGUAGE LEARNERS OF A TONAL LANGUAGE Mai-Anh Tran Ngoc[1], Ryan J. Giuliano[1], Nicole Y. Y. Wicha[1,2]; [1]University of Texas, San Antonio, [2]University of Texas Health Science Center, San Antonio — Languages are classified as "tonal" when pitch conveys word meaning. The use of lexical tone in one's native language elicits behavior and brain differences to perceived lexical tone and non-speech tones compared to non-tone language (nTL) speakers. In Experiment 1, we explored whether a person's ability to discriminate between pairs of non-speech tones would be affected by native tone-speaking experience (tone vs. non-tone speakers). In Experiment 2, we examined whether any similarities could be observed in beginner learners of Mandarin Chinese (learners vs. non-learners). Event-Related Potentials (ERPs) were recorded while participants with minimal musical experience listened to pairs of non-speech tones and determined by button press if the tones differed or not. Tone language (TL) speakers were more accurate than nTL at discriminating change versus no-change trials at several levels of pitch change, while exhibiting larger P1 amplitude and earlier peak latencies for the N1 and P300, indicating facilitated perceptual processing of pitch as compared to nTL. Although behaviorally there was no difference between learners and non-learners, learners elicited smaller P300s to pitch change trials after a month of Mandarin coursework than before exposure to the language, whereas no significant change was observed in non-learners over the same period. Interestingly, the training-related decrease in P300 amplitude observed for learners paralleled that elicited by TL relative to nTL, suggesting facilitation in the categorization processes indexed by the P300. Overall, the findings indicate that experience with a tone language can impact both early bottom-up and later top-down processes for discriminating non-linguistic tones.

D66

IDENTIFICATION OF A NOVEL PSYCHOPHYSICAL PHENOMENON WITH TONE INTERVALS Yune-Sang Lee[1], Jay Hull[1], Richard Granger[1]; [1]Dartmouth College, Hanver, NH — People predominantly have very poor absolute pitch (ability to identify a tone frequency) but very good relative pitch (intervals between two tones). It has long been observed that melodies (> two tones) are better recognized than two-tone intervals, but it remains unknown what features render melodies more readily recognized than intervals. We tested two simple extensions of intervals: (i) elongating the duration of the interval's two tones, or (ii) adding repetitions of the two tones. The only difference is that the tones are continuous in (i) whereas silent gaps are interposed between tone repetitions in (ii): (i) long-C – long-E; vs. (ii) short-C – short-C – short-E – short-E. Subjects were presented with two intervals, either major 3rds or perfect 4ths transposed to any of the 12 keys, and were asked whether the sequences (regardless of key) were the same or different. For interval transpositions that were difficult to match, continuous note extension (i) resulted in slight recognition improvement. In contrast, note repetition (ii) yielded large and significant recognition improvement. Most subjects also reported a subjective phenomenological difference between conditions i and ii. Since the conditions are identical except for the presence of gaps between the notes, it is presumably the presence of new note "attacks" that triggers the substantial measured recognition improvement. We forward the finding as a novel primary psychophysical phenomenon: adding gaps to tone sequences of identical duration causes the sequence to become significantly easier to recognize, and to become subjectively perceived as melodic.

D67

DECODING THE REPRESENTATION OF COMPLEX SOUNDS IN THE BRAIN WITH MACHINE LEARNING Lysiane Bouchard[1], Marc Schönwiesner[1], Douglas Eck[1], Pascal Vincent[1]; [1]Université de Montréal — The application of machine learning classifiers to brain imaging data is a growing trend. These classifiers uses information in the distributed pattern of voxels to detect and categorize different brain states. Conventional fMRI analysis treats these patterns as unwanted noise. Recently, Kamitani & Tong (2005) located orientation filters in the human primary visual cortex (V1) using fMRI. Neurons in V1 capture spatial brightness modulations in images projected onto the retina. The authors trained a classifier that uses linear combinations of voxel responses to decode which modulation was perceived by the subject. The existence of analogous modulation filters for spectral and temporal modulations in sound has been proposed in the auditory system. In order to investigate this assumption, we use fMRI recordings of brain responses of 7 subjects listening to 49 different spectrotemporal modulations. We analyze the data by applying and comparing several standard machine learning classification algorithms, i.e. support vector machines, naïve Gaussian models and sparse logistic regression (LASSO). We construct classifiers that decode the modulations in the sounds presented to the subjects and identify regions of auditory cortex that encode these spectrotemporal features. A sideline of this project is the development of new machine learning algorithms specialized for neuroimaging.

D68

EXAMINING THE TEMPORAL REPRESENTATION OF PITCH IN AUDITORY CORTEX Blake Butler[1], Laurel Trainor[1]; [1]McMaster University — Pitch is derived in the auditory system through complex spectrotemporal processing involving both spatial and temporal mechanisms. Although the temporal mechanism is particularly important for pitch perception in adult listeners, little is known about its function or development. The current study evaluates the temporal representation of pitch at the cortical level in adults using EEG and iterated rippled noise (IRN). The IRN samples consisted of a segment of frozen white noise, repeated in 5 and 6 ms intervals to create 450 ms sounds with 200 and 167 Hz pitch sensations, respectively. The stimuli were high pass filtered to remove the resolvable harmonics. On 85% of trials (standards) the 167 Hz sound was presented, while the remaining trials (deviants) consisted of the 200 Hz sound. EEG waveforms were collected and a significant mismatch negativity (MMN) component was found in response to occasional changes in the perceived pitch of the IRN. This response was shown to be modulated to some degree by attention. MMN is thought to reflect the updating of auditory sensory memory traces and indicates that adults were able to discriminate the pitches of the two IRN stimuli. Since both stimuli contained information in the same spectral range, and there were no resolvable harmonics present, the brain must have based this pitch sensation largely on the temporal information coded in the IRN stimuli. We are now conducting this experiment with infants in order to investigate the development of the temporal mechanism for pitch.

D69

THE INFLUENCES OF TASK LOAD AND PREPARATION ON ENCODING AND RETRIEVAL FOLLOWING COMPLEX AUDITORY SCENES Ben Dyson[1]; [1]Ryerson University — In order to successfully interact within our environment, we must fine-tune our perceptual and memorial systems to cope with ever-changing demands. Task load is a critical influence on processing but the degree to which increases in task load may be offset by preparation is less well understood. The current data provide insights into the neural correlates of working memory by examining variations in scalp recorded event-related potentials (ERPs) as a function of both encoding selectivity (cued, uncued) and retrieval load (0, 1, 2) following complex auditory scene presentation. When encoding the auditory scene, neural responses in uncued conditions were critical in establishing that the pattern of data for N2 and P3 amplitude were best characterised by the degree of perceptual selectivity rather than magnitude of task load. When retrieving information from the auditory scene on the basis of visual prompts, an effect of cueing in P2 amplitude was followed by an effect of load in P3 amplitude, with the effects of task load being offset by cueing at later stages of retrieval. The reversal of the direction of ERP modulation between encoding and retrieval stages may reflect the principle of cognitive closure in that the greater the selectivity during encoding, the smaller the workload required during retrieval. The present study confirms the utility of ERP in collectively addressing central questions regarding encoding and retrieval processes, and the particular benefits of observing neural activity under passive and / or ambiguous demands.

D70

NEURAL ACTIVITY ASSOCIATED WITH SPORT AND NON-SPORT SOUNDS IN ATHLETES Elizabeth Woods[1], Pilar Archila[1], Sian Beilock[2], Arturo Hernandez[1]; [1]University of Houston, [2]University of Chicago — The age at which an individual begins to learn a new skill or concept has been shown to have an effect on acquisition of bird song, musical abilities, and first and second language. All of these domains have something in common: they require processing of auditory stimuli. However studies of auditory processing in another field, athletics, are lacking. Some evidence is now emerging that expertise in a sport can modulate both behavioral and neural responses and that expert athletes process information related to their own sport differently than other sports. Furthermore, it seems that the best professional athletes began playing their respective sport at an early age. Thus, the present study examined neural response to familiar and unfamiliar sport and non-sport environmental sounds in collegiate athletes. During the functional magnetic resonance imaging (fMRI) experiment, tennis and basketball players were presented with ten sport, (Ntennis = 5, Nbasketball = 5) and ten non-sport (Nfamiliar = 5, Nunfamiliar = 5) sounds that were repeated four times each. Preliminary analyses showed that age of acquisition of a sport modulated neural activity when processing sounds in that sport. Furthermore, athletes demonstrated differential neural activation for familiar and unfamiliar sport as well as non-sport sounds. This study has important implications for theories of athletic training, auditory processing, learning, and brain plasticity.

D71

TITLE: EFFECTS OF AUDITORY EXPERTISE ON TEMPORAL VOICE AREAS Jean-Pierre Chartrand[1], Guylaine Bélizaire[1], Isabelle Peretz[1], Pascal Belin[1,2]; [1]International Laboratory for Brain, Music and Sound (BRAMS), University of Montréal, Canada, [2]Voice Neurocognition Laboratory, Center for Cognitive Neuroimaging, University of Glasgow, UK — The cerebral regions involved in face perception and expert object recognition have been much studied, leading to a large debate about the modularity of face perception. In the auditory domain, the existence of 'temporal voice areas (TVA)' suggests that analogous questions on the domain specificity of voice perception and its role in expert auditory recognition can be asked. The goal of this study was to assess the extent to which the TVA are recruited in auditory experts by stimuli of expertise. Sixteen healthy participants (8 bird experts; 8 guitar makers) were recruited based on their respective auditory expertise. They first performed four auditory memory and discrimination tasks. Afterwards, they were scanned on a 3-Tesla scanner while 1) passively listening to vocal and non-vocal sounds (10-minutes "voice-localizer" scan) 2) performing a one-back auditory task with birdsongs, guitar sounds and vocal sounds presented in an event-related design. At the behavioural level, auditory expertise resulted in a significant interaction between expertise group and stimulus category. Individual voice-selective maps were created from the first fMRI run (vocal vs non-vocal). fMRi data revealed a corresponding interaction ($p<0.001$ uncorr.) between expertise group and stimulus category in the left TVA with greater response of voice-selective cortex to the category of expertise. These results indicate that expertise with an auditory category enhances response of voice-selective cortex to stimuli of expertise. These results reinforce the suggestion that voice-selective cortices could in fact reflect expertise - or prolonged exposure- with those stimulus categories, rather than pure voice-selectivity per se.

D72

FUNCTIONAL ORGANIZATION OF THE PLANUM TEMPORALE FOR SPATIAL VERSUS SENSORY-MOTOR PROCESSES: COMBINED DTI AND FMRI A. Lisette Isenberg[1], Kenneth Vaden[1], Kourosh Saberi[1], L. Tugan Muftuler[1], Greg Hickok[1]; [1]University of California, Irvine — There has been much debate recently over the functional role played by the planum temporale (PT) and its capacity in the dorsal auditory processing stream. Some studies indicate that regions in the PT support spatial hearing, whereas others demonstrate sensory-motor response properties. This multifunctionality has led to the claim that the PT is performing a common computational pattern matching operation, then routing the signals (spatial, object, sensory-motor) into an appropriate processing stream. An alternative possibility is that the PT is functionally subdivided with separate regions supporting various functions. We assess this possibility using a within subject fMRI block design. DTI data was also collected to examine connectivity. There were four auditory conditions: stationary noise, moving noise, listening to pseudowords, and shadowing pseudowords (covert repetition). Contrasting the shadow and listen conditions should activate regions specific to sensory-motor processes, while contrasting the stationary and moving noise conditions should activate regions involved in spatial hearing. Subjects (N=17) showed greater activation for shadowing in left posterior PT, area Spt, when the shadow and listen conditions were contrasted. While the motion vs. stationary noise contrast revealed greater activation in a more medial and anterior portion of left PT. Seeds from these two contrasts were then used to guide the DTI analysis in an examination of connectivity via probabilistic tractography. More robust projections to anterior frontal regions are seen from area Spt. Findings support a heterogeneous model of the PT, with functionally distinct regions for sensory-motor integration and processes involved in auditory spatial perception.

D73

ARE GAPS THE SOUNDS WITH ZERO INTENSITY? A STUDY OF EMPTY AND FILLED INTERVAL TIMING IN SUB-SECOND RANGE IN HUMAN AUDITORY SYSTEM Maria D. Evstigneeva[1], Daniel S. Kislyuk[2], Alexander A. Alexandrov[1]; [1]Saint-Petersburg State University, Russia, [2]Helsinki University of Technology, Finland — Aim of the study was to compare the mechanisms of empty (gaps) and filled (sounds) interval duration processing in sub-second range. Fist, we examined whether the state-dependent network model (SDNM), which appears to work well for sub-second range silent intervals, can explain sounds duration processing. The model's prediction, that a certain contraction of the interval between the comparison and the test stimuli will the impair accuracy of discrimination, fulfilled for silent, but not for filled intervals. Second, using auditory event-related potential (ERP) recording in the oddball-paradigm, we obtained a mismatch negativity response (MMN) to change in duration of the silent gaps (standard 25 ms, deviant 50 ms and vice versa) in the continuous tone. This response, never reported earlier, was compared to "classical" MMN elicited by duration change of a sound of the same temporal characteristics (25 and 50 ms). Both for sounds and gaps when the deviant was longer than the standard MMN had shorter latency than in the reversed setup, suggesting change detectors existence. Third, comparing ERPs to short and long gap, we found higher positivity in response to longer gaps at the frontal electrode sites in the 24-40 ms time window after gap offset (sound renewal after the gap). Thus, at the early stages gap duration processing is explained well by SDNM, with duration represented, e.g., by magnitude of response to sound renewal; dramatically different mechanisms seem to underlie sound duration processing. Further discrimination seems to be based on similar gap or sound change detector activity.

Thinking: Decision Making

D75

THE INHERENT REWARD OF CHOICE Lauren A. Leotti[1], Michael A. Niznikiewicz[1], Mauricio R. Delgado[1]; [1]Rutgers University, Newark — Individuals exercise control over the environment by making choices. Behavioral studies in animal and human decision-making illustrate that choice is highly desirable, however little is known about whether choice, itself, is rewarding. Using fMRI, we characterize the hedonic experience of choice by examining brain activity during the anticipation of choice (vs. non-choice). Participants were informed that their goal was to earn as much play money as possible, which would be translated into bonus cash. On each trial, participants were presented with a selection of two keys which could lead to a gain of $0, $50, or $100. On some trials, participants would have the opportunity to choose between the two keys (choice condition). On other trials, however, they were forced to accept the computer-selected key (no choice condition). Participants learned to associate symbolic cues with upcoming choice or non-choice trials. Because choice and non-choice trial types are matched in expected value, any differences in behavioral ratings and BOLD activity between conditions can be interpreted as affective valuation of choice itself. Participants reported liking the choice trials better than the non-choice trials. Relative to the non-choice cue, the choice cue elicited increased activity in a network of regions involved in reward processing and goal-directed behavior, including the orbital frontal cortex, striatum, inferior parietal lobule and dorsal anterior cingulate cortex. As converging evidence suggests the perception of control is integral for an individual's general well-being, these preliminary results have important implications for understanding how exercising control modulates affective responses.

D76

MATURATION OF LIMBIC CORTICOSTRIATAL ACTIVATION AND CONNECTIVITY ASSOCIATED WITH DEVELOPMENTAL CHANGES IN TEMPORAL DISCOUNTING Anastasia Christakou[1,2], Mick Brammer[2], Katya Rubia[2]; [1]University of Reading, [2]Institute of Psychiatry, King's College London — Temporal discounting matures with age, alongside other markers of increased impulse control, and coherent, self-regulated behaviour. Discounting paradigms quantify the ability to refrain from preference of immediate rewards, in favour of delayed, larger rewards. As such, they measure temporal foresight and the ability to delay gratification, functions which develop slowly from late childhood into adulthood. We investigated the neural maturation that accompanies the previously observed age-related behavioural changes in discounting, from early adolescence into mid-adulthood. We used functional magnetic resonance imaging of a hypothetical discounting task with monetary rewards, delayed in the week to year range. We show that age-related reductions in choice impulsivity were associated with changes in activation in ventromedial prefrontal cortex (vmPFC), anterior cingulate cortex (ACC), ventral striatum (VS), insula, parahippocampal and inferior temporal gyrus, and posterior parietal cortex. Limbic corticostriatal activation changes were specifically associated with age-dependent reductions in impulsivity, as part of a more extensive network of brain areas showing age-related changes in activation (including dorsolateral PFC, parietal cortex, and additional subcortical areas). The maturational pattern of functional connectivity included strengthening in activation coupling between ventromedial and dorsolateral PFC, parietal and insular cortices during selection of delayed alternatives, and between vmPFC and VS during selection of immediate alternatives. We conclude that maturational mechanisms within limbic corticostriatal circuitry underlie the observed post-pubertal reductions in impulsivity with increasing age, and that this effect is dependant on increased activation coherence within a network of areas associated with discounting behaviour and inter-temporal decision-making.

D77

IS THE GAIN WORTH THE PAIN? THE WILLINGNESS TO SUFFER FOR MONETARY GAIN Soyoung Q. Park[1,2,4], Thorsten Kahnt[3,4], Jörg Rieskamp[2,5], Hauke R. Heekeren[1,2,4]; [1]Cluster of Excellence "Languages of Emotion," Freie Universität Berlin, Germany, [2]Max Planck Institute for Human Development, Berlin, Germany, [3]Bernstein Center for Computational Neuroscience, Berlin, Germany, [4]Berlin School of Mind and Brain, Humboldt Universität zu Berlin, Germany, [5]Institute for Psychology, Universität Basel, Switzerland — In everyday situations, we usually face options that have more than one dimension. Each dimension can implicate either losses (e.g., costs to buy a bike) or gains (e.g., technical benefit of a bike). It has been suggested that these different dimensions are converted into a single internal common value currency to facilitate the comparisons of the valuation of diverse future behavioral acts or stimuli, thereby enabling successful decision making. This common value currency of an option can be referred to as the subjective value, incorporating individual weighting of each dimension. The goal of the present study is to examine the neural representation of such integrated subjective values and the decision-making mechanism underlying choices among multi-dimensional options. We investigated 23 healthy male subjects using functional magnetic resonance imaging (fMRI) while they chose among multi-dimensional options. Each option consisted of physical pain (electrical pulse) and monetary gain. Crucially, subjects received both the amount of money and strength of pain of the chosen option. Different sub-regions of the prefrontal cortex correlated with the magnitude of money and the severity of pain, respectively. Furthermore, we fitted individual behavioral data to economic models simulating the cost benefit integration to estimate the subjective value for each complex option. Using these subjective values, we demonstrate that the medial prefrontal cortex, a region that has been previously shown to code single dimensional reward value, also codes the integrated subjective value.

D78

THE FRN IS ASSOCIATED WITH THE EXPECTATION Yin-Fang Chang[1], Nai-Shing Yen[1,2], Chia-Yuan Lin[1], Chun-Yu Chen[1], Chang-Hao Kao[1]; [1]National Chengchi , Taipei, Taiwan, [2]Research Center of Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan — Feedback-related negativity (FRN) is a brain potential peak at 250-300ms after feedback. In particular, FRN has been shown to reflect the evaluation of monetary loss, negative feedback and unexpected feedback. The present study is designed to evaluate the role of expectation on FRN. By varying the probability of positive feedback, expected or unexpected gains were manipulated. In this study, the probability of positive feedback was divided into two conditions. In high gain condition, the probability of receiving positive feedback is 75%. In low gain condition, the probability of receiving positive feedback is 25%. That means, the positive feedback is expected in high gain condition but unexpected in low gain condition, whereas the negative feedback is unexpected in high gain condition but expected in low gain condition. A 2(condition) X2(feedback) X3(electrode) ANOVA was performed and revealed that a significant interaction of condition and feedback. A greater FRN was found in positive feedback in low gain condition than in high gain condition. That is, the FRN is greater when the positive feedback is unexpected than expected. However, P300, an ERP component which reflects the event probability, might result in the interaction difference. To clarify this confounding, the difference wave was used. Unexpected feedback (loss in high gain condition - gain in low gain condition) was significantly greater than expected feedback (loss in low gain condition - gain in high gain condition). These findings suggest that the FRN is sensitive to unexpected events. The reinforcement learning theory of FRN is supported.

D79

PAVLOVIAN-TO-INSTRUMENTAL TRANSFER – NEURAL MECHANISMS AND RELEVANCE FOR OBESITY Sanne de Wit[1], Paul Fletcher[2], Reinout Wiers[1], Richard Ridderinkhof[1]; [1]University of Amsterdam, [2]University of Cambridge — Outcome-specific Pavlovian-to-Instrumental Transfer (PIT) takes place when environmental cues that predict reward bias behaviour towards actions associated with that same reward. To investigate the relevance of PIT effects for human food-seeking we conducted three experiments that build on previous demonstrations of this effect in humans (Hogarth et al., 2007; Bray et al., 2008). In the paradigm common to all experiments, participants received two separate training phases. During Pavlovian training, visual stimuli on the computerscreen signalled the free presentation of food pictures and points towards the actual food reward. During instrumental training, participants were required to make responses (either right or left key press) to earn these same food rewards. Subsequently, in the critical extinction test, participants were asked to choose between pressing either the right or left key as quickly and spontaneously as possible upon presentation of the Pavlovian stimuli. The results of Experiment 1 show that Pavlovian cues bias choice towards the commonly associated food reward regardless of post-training reward devaluation through specific satiety, although participants did react significantly slower to cues that signalled pre-fed food. In Experiment 2, overweight adolescents showed a stronger PIT effect for high- than for low-calorific food rewards, in contrast to their lean peers. Finally, in Experiment 3, participants were tested inside the fMRI scanner while performing the extinction test, and putamen (extending into pallidum) was implicated in outcome-specific PIT (see also Bray et al., 2008). The results of these experiments suggest that PIT may contribute to excessive food-seeking in an obesogenic environment.

D80

PROPOSERS WITH THE SAME NATION ELICIT GREATER CONFLICT IN AN ULTIMATUM GAME: A FRN STUDY Nai-Shing Yen[1,2], Yin-Fang Chang[1], Li-I Hsu[1], Kuan-Ying Lin[1], Chang-Hao Kao[1]; [1]National Chengchi , Taipei, Taiwan, [2]Research Center of Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan — In the Ultimatum Game, participants (responders) can either accept or reject the offer that is proposed by another person (proposer). It is typically found that participants reject offers that are more unfair and accept offers that are fairer. In our experiment, the gender and nationality of the proposer were manipulated. In nationality, the proposer could be either a Taiwanese (the same nation with the responder) or a Foreigner (different nation with the responder). The reaction time and EEG data were recorded. Eighteen undergraduates from National Chengchi University were recruited as participants. In reaction time data, a 2(nationality) X2(gender) X5(offer) ANOVA was performed. The main effect of offer was observed. The difference of reaction time in different offers might reflect the level of conflict of the offers. That is, low conflict offers are easier to react, but high conflict offers are more difficult to react. According to this hypothesis, high conflict offers and low conflict offers are differentiated. A 2(nationality) X2(gender) X2(level of conflict) ANOVA was performed and revealed a significant difference of the level of conflict. The FRN, a component of ERP, which is related to error and conflict detection, was analyzed. A 2(nationality) X2(level of conflict) ANOVA revealed that the interaction of nationality and the level of conflict was significant. It shows that, in high conflict offers, the proposers who are Taiwanese can elicit greater FRN than the foreign proposers. It suggests that the conflict offer proposed by people on their own side is more difficult to react.

D81

THE INFLUENCE OF EXPECTED VALUE AND RISK LEVEL IN A REVERSED VERSION OF MODIFIED IGT Chang-Hao Kao[1], Nai-Shing Yen[1,2], I-Chen Chou[1], Hui-Kuan Chung[1], Bie-Shuein Chu[1]; [1]National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan — Bechara et al. (1994) designed an Iowa Gambling Task (IGT) to examine the somatic maker hypothesis (SMH) and the similar result was also found in a reversed version of IGT (Bechara et al., 2000). However, Windmann et al. (2006) used an original IGT and a reversed IGT to examine framing effects in IGT. Their results showed that different behaviors and brain activation in original and reversed IGT. Recently, Yen et al. (2009) developed a modified IGT (IGT-M) to clarify the effects of risk level and expected value in decision making. They found significant interaction between expected values and risk level in behavioral and physiological data. Thus, in the present study, a reversed IGT (IGT- M') with reversed contingency schedule of IGT-M is used to clarify the framing effect in a modified IGT. In IGT-M', the good decks consisted of high immediate loss and high delayed gain, whereas the bad decks consisted of low immediate loss and low delayed gain. Other designs were the same as IGT-M and physiological data were also collected. In the present study, a significant interaction between expected values and risk level was shown in IGT-M but not in IGT- M'. The different pattern was also found in physiological data. In IGT-M', higher SCR was induced before and after choosing the preferred deck. Additionally, similar result in EEG data showed higher alpha-band power before the selection of the preferred deck.Therefore, the SMH is not supported.

D82

INTERACTION BETWEEN IN ACTION AND VALENCE ANTICIPATION IN THE HUMAN STRIATUM AND DOPAMINERGIC MIDBRAIN Marc Guitart-Masip[1,2], Lluis Fuentemilla[1], Dominik Bach[2], Quentin Huys[3], Peter Dayan[3], Ray Dolan[2], Emrah Duzel[1,4]; [1]Institute of Cognitive Neuroscience, University College London, United Kingdom, [2]Wellcome Trust Centre for Neuroimaging, Institute of Neurology, University College London, United Kingdom, [3]Gatsby Computational Neuroscience Unit, University College London, United Kingdom, [4]Institute of Cognitive Neurology and Dementia Research, Otto-von-Guericke-Universität, Magdeburg, Germany — The midbrain dopaminergic system and the striatum have a prominent role in reward learning, but the involvement of this system in punishment processing is more controversial. Recent evidence suggests that the dopaminergic system may be related to action learning and execution regardless of the valence of the associated outcomes. To test this hypothesis, we scanned subjects with a high resolution fMRI protocol while they performed a new task in which action and valence were independently manipulated. Behaviourally, subjects were faster and more successful at doing a task to win than to avoid losing money. The fMRI results showed that the striatum mainly responded to action anticipation. In the midbrain we found a dorsolateral cluster that mainly responded to action anticipation and a more ventromedial cluster that showed increased activity to the anticipation of action in the win condition and decreased activity to the anticipation of action in the lose condition. Confirming our hypothesis, the midbrain dopaminergic system and the striatum mainly encoded the anticipation of motivationally driven action irrespective of whether the associated outcomes were positive or negative. However, we also show that midbrain dopaminergic system is heterogenous and have anatomically distinct functional areas with different sensitivity to reward and punishment.

D83

INDIVIDUAL DIFFERENCES IN RELATIVE SUSCEPTIBILITY TO SELF AND CHARITY FRAMING EFFECTS David V. Smith[1], Vinod Venkatraman[1], R. McKell Carter[1], John A. Clithero[1], Justin R. Meyer[1], J. H. Pate Skene[1], Michael L. Platt[1], Scott A. Huettel[1]; [1]Duke University — People can exhibit marked differences in their choices depending on how a decision is presented. Many real-world decisions differ in their consequences, with some decisions impacting the individual making the decision and other decisions impacting other individuals. Yet, little is known about how economic preferences change depending on the specific target of a decision. Here we used fMRI to measure brain activation while participants (n = 64) engaged in a financial decision-making task that has been previously used to study framing. On each trial, participants were shown a starting amount ($10, $20, $30, $40) before choosing between "sure" and "gamble" options. The sure option was framed such that the participant could keep (gain frame) or lose (loss frame) a fixed proportion of the starting amount. The gamble option did not differ according to frame and was represented by a pie chart reflecting the probability (25%, 50%, 75%) of winning or losing the entire starting amount. On half the trials, participants played for themselves, and on the other half of the trials, they played for a charity of their choice. Consistent with a framing effect, we observed increased gambling in loss frames compared to gain frames, an effect that was greater during charity trials. Strikingly, an individual's relative susceptibility to self and charity framing effects was predicted by activation in ventromedial prefrontal (vmPFC) during an analogous contrast (self trials > charity trials). These results suggest vmPFC mediates individual differences in relative decision biases for self and charity framing effects.

D84

NEURAL SIGNALS OF SOCIAL BIAS IN DECISION MAKING Simon Evans[1], Bruno Averbeck[1], Steve Fleming[2], Ray Dolan[2]; [1]UCL Institute of Neurology, [2]Wellcome Trust Centre for Neuroimaging, UCL — Real-world decision-making usually involves at least some social considerations; consequently, the social value of stimuli can induce bias effects in how choices are made. We investigated how smiling and angry face stimuli influenced the way subjects behaved in a stochastically-rewarded decision-making task. Subjects were asked to determine through trial and error which of two emotional faces were associated with a higher probability of reward. The task was performed in an fMRI scanner. Subjects were reliably biased in favour of smiling faces, presumably reflecting the social value of such stimuli as approving or trustworthy. We then referenced behaviour to a Bayesian RL model which predicted subject choice confidence on each trial. Two models were used: an ideal-observer which behaved optimally, and a biased model which incorporated a prior and learning bias towards the emotional expression. Trial–by trial predictions from each of the models were regressed on the fMRI data. Activity in striatal reward processing areas correlated with the ideal-observer, whereas the additional expression bias correlated with the dmPFC which has been implicated in the computation of social value. We also examined between-subject differences in behaviour; amygdala activity was associated with the level of prior bias towards smiling faces, activity in insula and ventral striatum reflected negative and positive feedback learning performance respectively.

D85

BEAUTY OR FAME: UNCOVERING THE POWER OF CELEBRITY SOCIAL INFLUENCE Adam Craig[1], Stacy Wood[1], David Smith[2], Scott Huettel[2], Jennifer Vendemia[1]; [1]University of South Carolina, [2]Duke University — Attractive faces have been suggested to be rewarding (or positive reinforcers). Yet, the effect of social factors, including familiarity and social status, on the rewarding properties of attractive faces remain unclear. Although repeated exposure increases attractiveness, familiarity arising from cultural status may differentially impact attractiveness. Here we examine how activation generated by rewarding faces may be moderated by type of familiarity: novel, familiarity based on conditioning, and recognized celebrity. Celebrity status may be due to repeated exposure however, we predict that the combination of social status and attractiveness will be more impactful than familiarity based on conditioning. To build on prior studies of attractiveness and demonstrate sensitivity to social characteristics, we utilized a 2 (Attractiveness: high, low) x 3 (Social Category: Celebrity, Familiar, Novel) functional magnetic resonance imaging design wherein participants rated faces for attractiveness. Faces were rated by a prior cohort to determine "high" and "low" categorization. Familiar and Celebrity manipulations were implemented by presenting faces three times during a viewing task 5 minutes prior to functional scanning. Within the FFA, the high-attractive, familiar condition evoked larger activation compared to low-attractive, familiar whereas high-attractive celebrity and low-attractive, celebrity did not differ. Within the dACC, high-attractive, celebrity evoked larger activation compared to low-attractive, celebrity whereas low and high attractive familiar conditions did not differ. Overall, this study has implications for social information processing: the brain may treat cultural constructs such as celebrity differently than familiarity.

D86

THE DIFFERENTIAL EFFECTS OF RISK AND AMBIGUITY ON EVALUATING FUTURE REWARDS Marianna Blackburn[1], Rebecca Elliott[2], Wael El-Deredy[1]; [1]School of Psychological Sciences , The University of Manchester, UK, [2]Neuroscience and Psychiatry Unit, The University of Manchester, UK — It has been argued that delayed rewards are discounted as a function of time because they incorporate increased uncertainties; however, there are no studies to date which have demonstrated this experimentally. We investigated whether participants incorporated uncertainty into their evaluation of a delayed reward, or whether their judgments were based on absolute reward magnitudes. Thirty-two participants completed three computerised discounting tasks for small and large delayed rewards. The tasks included a standard delay discounting paradigm in conjunction with two modified versions: in one, delayed rewards were framed in terms of risk (known reward magnitude but with large variance of decision outcome), whereas the other task framed delayed rewards in terms of ambiguity (definite rewarding outcome but with large variance in the reward magnitude). The expected value of rewards in the three tasks was kept the same, such that changes to the parameters of the discounting curve (area under the curve and k - the rate of discounting) could be stipulated to arise from framing effects. Results: There was no significant difference in area and the curve between the risky task and the standard delayed discounting task. However, ambiguously framed rewards were less discounted than both standard and risky ($F = 11.59$; $p = 0.00$), suggesting a shift of the discounting curve towards a more self-controlled choice behaviour. Further, the findings suggest participants' automatically evaluate delayed rewards by incorporating risk, and that impulsive choice may be modified more by framing of delayed rewards than time preferences.

D87

BEHAVIOURAL AND NEURAL RESPONSES DIFFER BETWEEN PARKINSON'S DISEASE PATIENTS WITH AND WITHOUT DOPAMINE AGONIST-ASSOCIATED PATHOLOGICAL GAMBLING: AN FMRI STUDY Crystal Erickson[1], Lauren Templeton[1], Brigitte Stemmer[2], Michel Panisset[2], Alain Dagher[1]; [1]Neurol and Neurosurgery, McGill University, Montréal, Quebec, [2]Hopsitalier de l'Université de Montréal., Montréal, Quebec — One increasingly common side effect to the administration of dopaminergic medication to Parkinson's disease (PD) patients is pathological gambling (PG), reported in up to 8% of patients, which is well above the 1% prevalence rate in the normal population. The underlying neural mechanism of PG susceptibility is not clear, therefore, this study aimed to investigate the neural response to gambling in 12 PD and 12 age-matched (AM) controls with no history of PG, and 11 PD patients diagnosed with PG (PGPD group). Behaviourally PGPDs differed from PD and AM controls, showing a shift toward higher or riskier bets, supporting our lab's previous findings in PG's without PD. Young, healthy controls show significant

BOLD activation in the NAc and VTA in response to the gambling task, while PDs do not. We saw neither a hyperactive nor hypoactive response in the NAc or VTA in the PGPDs, and what neural differences we did see was most likely explained by age or PD, but not PG. We did find that the PGPD's differed significantly from PD and AM controls in the ACC, PFC, and Insula in both the anticipation phase of winning, and the feedback phase of losing. These areas are involved in adaptive decision making, processing of risk, loss and error prediction. Therefore, our study suggests that PGPDs do not differ from AM and PD controls in the typical NAc/VTA reward circuitry involved in gambling. Instead they differ in other regions involved in decision making, processing of risk, loss and error prediction.

D88

INFLUENCE OF INSTRUCTED KNOWLEDGE ON REINFORCEMENT-LEARNING Jian Li[1], Mauricio Delgado[2], Elizabeth Phelps[1,3]; [1]New York University, NY, [2]Rutgers University, Newark, NJ, [3]Center for Neural Science, New York University, NY — Proper decision-making with uncertain outcomes is influenced by various factors and reinforcement learning (RL) is a powerful tool in understanding behaviors in tasks with trial and error, and its neural underpinnings have been extensively studied using both neurophysiology and functional neuroimaging (fMRI) techniques. Explicit memory system, however, can exert its influence by providing a strong prior in guiding subjects' choices. We designed two two-arm bandit tasks together with fMRI to test how these two systems might be differentially involved. Subjects can only learn through trial and error in the first task (task 1), while in second task (task 2) we provided subjects with extra explicit knowledge: the probability of each choice that leads to reward. Subjects' choice behavior and neural activities are well captured using RL algorithms in task 1 but not task 2. More specifically, prediction error signals are well correlated with neural activities in the ventral striatum in task 1 but not task 2. Also, activation in the nucleus accumbens (NAc) is significantly higher to the positive outcome in task 1 than task 2, which corresponds well with the fact that subjects in task 1 are more likely to stick with current choices when the outcome is positive than in task 2. The activities of bilateral hippocampus are consistently engaged in task 2, irrelevant of trial difficulty, while they negatively correlate with trial difficulty in task 1. Our findings showed how different decision-making machineries are enacted and balanced to guide choices when available information varies across tasks.

D89

INSTRUCTIONAL CONTROL OF REINFORCEMENT LEARNING: A NEUROCOMPUTATIONAL AND GENETIC ACCOUNT Bradley Doll[1], Michael Frank[1]; [1]Brown University — Much research suggests that the brain learns to maximize reward and minimize punishment through dopaminergic prediction error signals. Though such a learning system is adaptive, it is slow and time consuming, requiring repeated experience with outcomes. A quicker way to learn is through rules, instructions, and advice from others. Such learning, however, comes at the cost of sensitivity to true reward contingencies. Here we explore the neurocomputational underpinnings of how simple verbal information affects reinforcement learning. Subjects were given accurate or inaccurate information about how to best perform a probabilistic selection task. Instruction-consistent responding was persistent and specific to the instructed stimulus. Neural network simulations suggest two possible neural circuits produce the effect. In the first, verbal information representations in prefrontal cortex directly project to and bias striatal action-values through dopaminergic prediction errors, constituting a confirmation bias. In the second, the striatum learns the true reward contingencies through feedback, but does not express this learning in behavior because it is overridden at motor cortex by prefrontal instruction representations. We collected DNA and analyzed genes implicated in controlling dopaminergic efficacy in striatum and prefrontal cortex. Biological support for the candidate models is indicated by the extent to which prefrontal cortex and striatum compete in following instructions rather than contingencies (override model) or cooperate by combining instruction with task contingent feedback in assigning value to the stimuli (bias model). Preliminary analysis lends support for both interpretations, suggesting that multiple mechanisms may be at play either within or across individuals.

D90

ANTERIOR CINGULATE CORTEX UNDERGOES THETA-BAND PHASE-LOCKING WITH RIGHT FRONTAL CORTEX DURING FEEDBACK PROCESSING IN A GAMBLING TASK Gregory Christie[1], Matthew Tata[1]; [1]The University of Lethbridge — The neural mechanisms for processing rewarding and punishing feedback can be studied using free-choice gambling-type tasks with variable risk and reward. In a previous study we adapted the Iowa Gambling Task to investigate the effect of implicit risk on the neurophysiology of feedback processing. We observed a characteristic increase in theta-band (4 – 7 Hz) EEG power in medial-frontal cortex that was modulated by the riskiness of the selected bet but not by its outcome (i.e. it was not affected by valence). This increased theta-band activity may reflect phase-locking of distinct cortical regions as they dynamically exchange and process information. In the present study we replicated our previous findings and have extended our analysis by investigating theta-band phase locking between anterior cingulated (ACC) and a number of candidate regions in frontal cortex known to be electrically active during feedback processing. EEG was recorded using 128 scalp electrodes while participants played a simulated gambling game. We used a source montage approach to model theta-band activity in ACC, bilateral dorsolateral prefrontal cortex (dlPFC), and bilateral mediofrontal gyrus (MFG). Phase-locking was measured between ACC and each of the frontal sources. We observed significant phase-locking between ACC-dlPFC and ACC-MFG that was modulated by the riskiness of the selected choice. This theta phase-locking was also right-hemisphere lateralized across experimental conditions. These results suggest that feedback processing engages a synchronous theta-band network in right-hemisphere frontal cortex, and that this network is sensitive to the perceived riskiness of a chosen action.

D91

THE NEURAL OPERATIONS ASSOCIATED WITH DIETARY SELF-CONTROL ARE MODULATED BY THE SALIENCE OF TASTE AND HEALTH INFORMATION Jonathan Malmaud[1], Todd Hare[1], Colin Camerer[1], Antonio Rangel[1]; [1]California Institute of Technology — We tested the hypothesis that the salience of taste and health information affects the brain's ability to deploy the processes that have been associated with successful self-control. Subjects were scanned using fMRI while they made decisions about whether or not to eat healthy and unhealthy food items. The salience of health or taste factors was manipulated by having subjects focus on either the healthiness or the taste of a food before making the decision. In a third, baseline condition subjects were told to focus on whatever came naturally to them. We found that subjects made more healthy choices in the health saliency condition. Furthermore, activity in ventromedial prefrontal cortex (VMPFC), an area that has been shown to encode the value of stimuli at the time of choice, was modulated by the saliency condition: the correlation with health ratings was strongest during health saliency trials, and the correlation with taste ratings was strongest during the taste saliency trials. We also found that there was greater dorsolateral prefrontal cortex (DLPFC) activity when subjects exercised self-control in the taste focus condition, and less DLPFC activity when subjects used self-control in the health focus condition as compared to baseline. Together, these data suggest that increasing the salience of health-related factors might facilitate self-control during dietary choice.

D92

THE NEURAL CODE OF REWARD ANTICIPATION IN HUMAN ORBITOFRONTAL CORTEX Thorsten Kahnt[1,2,3], Jakob Heinzle[1], Soyoung Park[3,4], John-Dylan Haynes[1,2,3]; [1]Bernstein Center for Computational Neuroscience, Charité – Universitätsmedizin Berlin, Germany, [2]Max Planck

Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [3]Graduate School of Mind and Brain, Humboldt Universität zu Berlin, Germany, [4]Max Planck Institute for Human Development, Berlin, Germany — An optimal choice among alternative behavioral options requires precise anticipatory representations of their possible outcomes. A fundamental question is how such anticipated outcomes are represented in the brain. Reward signals arising from dopaminergic midbrain neurons have been suggested to broadcast value information to the prefrontal cortex. However, the exact format of reward representations in cortical areas has remained unclear. Reward coding at the level of single-cells follows a more heterogeneous coding scheme than suggested by studies using functional magnetic resonance imaging (fMRI) in humans. Using a combination of multivariate pattern classification and fMRI we show that the reward value of sensory cues is encoded in distributed response patterns in the orbitofrontal cortex. This distributed encoding is compatible with previous reports from animal electrophysiology showing that reward is encoded by different neural populations with opposing coding schemes. Importantly, the response patterns encoding specific values during anticipation are similar to those that emerge during the receipt of reward. Furthermore, we show that the degree of this similarity is related to subjects' ability to use value information to guide behavior. These results bridge the gap between reward coding in human and animals and corroborate the notion that value representations in prefrontal cortex are independent of whether reward is anticipated or actually received.

D93

THE ROLE OF THE NORADRENERGIC SYSTEM IN THE EXPLORATION-EXPLOITATION TRADE-OFF: A PHARMACOLOGICAL STUDY Marieke Jepma[1,2], Eric-Jan Wagenmakers[3], Erik te Beek[4], Joop van Gerven[4], Sander Nieuwenhuis[1,2]; [1]Leiden University, [2]Leiden Institute for Brain and Cognition, [3]University of Amsterdam, [4]Centre for Human Drug Research — Animal research and computational modeling have indicated an important role for the locus coeruleus-norepinephrine (LC-NE) system in the regulation of attention and behavior. According to the adaptive gain theory of LC function, the LC-NE system is critical for the optimization of behavioral performance by regulating the trade-off between exploitative and exploratory behavioral strategies (Aston-Jones & Cohen, 2005). However, crucial direct empirical tests of this theory in human subjects have been lacking. We made use of a pharmacological manipulation of the human noradrenergic system to test predictions of this theory in humans. In a double-blind parallel-groups design, participants received 4 mg reboxetine (a selective norepinephrine reuptake inhibitor), 30 mg citalopram (a selective serotonin reuptake inhibitor) or placebo. By inhibiting the reuptake of NE, reboxetine increases the tonic NE level. We assessed the effects of reboxetine on performance in several cognitive tasks designed to examine exploitative versus exploratory behavior. The adaptive gain theory would predict that the increased tonic LC level induced by reboxetine promotes exploratory behavior. In contrast to the prediction of the adaptive gain theory, we did not find differences in exploratory behavior between the three experimental groups. Our findings suggest that multiple factors, such as individual differences in personality, motivation, stress and other neuromodulatory systems, have to be taken into account in order to increase our understanding of the noradrenergic modulation of behavioral strategy.

D94

INDIVIDUAL DIFFERENCES IN ANTICIPATION OF AND PREFERENCES FOR DISTINCT REWARD CATEGORIES John A. Clithero[1], Crystal C. Reeck[1], R. McKell Carter[1], David V. Smith[1], Vinod Venkatraman[1], Justin R. Meyer[1], J. H. Pate Skene[1], Michael L. Platt[1], Scott A. Huettel[1]; [1]Duke University — Humans respond to a wide range of rewards. Although prior research shows that modality alters sensitivity to different types of reward, the role of individual differences in shaping neural reward circuitry remains unclear. We scanned 63 participants using event-related functional magnetic resonance imaging (fMRI) while they performed a modified version of the monetary incentive delay (MID) task. At the start of each trial, participants viewed one of five cues that indicated a potential reward of cash ($1 or $5), candy (small or large amount), or nothing. Then, after a short anticipation interval, participants pressed a button to a visual target to receive the reward. We collected saliva samples for assessment of genetic contributions to reward processing. Reward anticipation robustly increased blood-oxygenation-level-dependent (BOLD) signal in ventral striatum, confirming prior hypotheses. This anticipatory activation was present in both reward modalities. Consistent with the hypothesis that reward anticipation shares a common neural substrate across modalities, participants with greater anticipation sensitivity on money trials also had greater anticipation sensitivity on candy trials. We also found significant variation in reaction times within participants and across reward modalities, which can be used as an inferred measure of relative preference. Strikingly, relative BOLD signal changes in both the striatum and medial prefrontal cortex tracked those within-participant differences in inferred preferences. These results point to individual differences in a common reward substrate and are evidence for variation in motivation for primary and secondary rewards that may have genetic underpinnings.

D95

STIMULUS AND ACTION VALUE REPRESENTATIONS DURING SIMPLE ECONOMIC CHOICE Todd Hare[1,2], Wolfram Schultz[3], Colin Camerer[1,2], Antonio Rangel[1,2]; [1]Division of Humanities and Social Sciences, California Institute of Technology, [2]Computation and Neural Systems Division, California Institute of Technology, [3]Development, and Neuroscience, University of Cambridge — We tested the hypothesis that the brain computes and utilizes both stimulus and action values during economic choice. Stimulus values represent the reward associated with an object regardless of the action required to obtain the object. Action values denote the value of performing a given action regardless of the identity of the reward obtained. Subjects were scanned using fMRI while they made choices between juice rewards. On each trial, subjects were shown two cues representing a particular flavor and amount of juice on each side of the screen. Subjects were instructed to make their choice between the two options while the cues were on the screen. After a delay of 3-6 seconds, a response prompt appeared and subjects pressed with the right thumb to obtain the right option and the left thumb to obtain the left option. The selected juice was delivered to the subject following a 3-6 second delay. Stimulus and action values for each subject were derived from the choice data and used as parametric regressors in the fMRI analysis. We found that both stimulus and action value were represented at the time of choice. Stimulus value positively correlated with activity in the medial orbitofrontal cortex. The values of the right and left actions were positively correlated with activity in contralateral primary and supplementary motor cortex. Thus, neural activity reflects both stimulus and action value computations during economic choice. An important next step will be to determine the functional pathways between networks computing stimulus and action values.

D96

REWARD AND RISK REPRESENTATION DIFFERENCES FOR SELF AND OTHERS R. McKell Carter[1], John A. Clithero[1], Vinod Venkatraman[1], David V. Smith[1], Adrienne A. Taren[1], Justin R. Meyer[1], O'Dhaniel A. Mullette-Gillman[1], Elizabeth T. Cirulli[1], David B. Goldstein[1], J. H. Pate Skene[1], Michael L. Platt[1], Scott A. Huettel[1]; [1]Duke University — Making a decision in a social context requires neural representations of risks and rewards for both oneself and others. In some circumstances, rewards for self and others may evoke similar neural representations. However, whether self-regarding and other-regarding risks and rewards share common neural substrates has not been demonstrated. Here, we sought to identify differences in risk and reward representation that may be common across participants and that may reflect trait differences. We acquired functional magnetic resonance imaging data (fMRI) in 62 adult participants during a passive gambling task. Participants viewed a series of risky gambles with a probability of winning a prize for either themselves or a chosen charity. To examine individual trait differences, we also collected behavioral measures of attitudes toward risk and reward as well as saliva samples for genetic analysis. Regressors representing risk on self trials correlated with activation in the inferior prefrontal cortex (PFC), posterior parietal cortex, and temporal-occipital junction, consistent with previous work. On charity trials, the representation of risk was similar to that for self. Examination of activation during gamble outcome presentation for self reveals significant activation in areas normally associated with reward including ventral striatum and medial prefrontal cortex. We also found evidence of brain areas where risk-related activation differences between individuals covaried with a behavioral measure of participants' risk preferences.

D97

LEARNING AND GENERALIZATION IN HUMAN REINFORCEMENT LEARNING G. Elliott Wimmer[1], Daphna Shohamy[1], Nathaniel D. Daw[2]; [1]Columbia University, [2]New York University — The responses of primate dopamine neurons and BOLD signals in human striatum are well accounted for by reinforcement learning (RL) models. The simplest such models are blind to higher-order task structure, such as the relation between multiple cues or events. However, organisms do encode relational knowledge and use such knowledge to guide decisions. Converging evidence suggests that this kind of relational learning depends on the hippocampus. It is unclear whether the putative striatal RL system enjoys this sophistication: RL models often view the striatum as lacking such capacity and also as competing against hippocampal processes. We used fMRI together with computational modeling to examine striatal and hippocampal activity while subjects made repeated choices in a 'four-armed bandit' task with a hidden relational structure provided by correlated payoffs between cues. Behavioral and fMRI results suggested that subjects' valuations were influenced by the equivalence between gambles, such that information about reward outcomes for one gamble generalized to its partner. Behaviorally, subjects' choices were better predicted by an augmented RL model that permitted such generalization. Value-related BOLD activity was found in the mPFC and additionally in the hippocampus, and prediction error activity was found in the striatum. The striatal prediction error signal was better explained by a model that included relational information. These results suggest that sensitivity to higher-order structure is present in subcortical RL systems and that this learning may be aided by the hippocampus, consistent with models that posit cooperation between RL systems and relational learning via learned stimulus representations.

D98

ATTITUDE COMPLEXITY AND THE ROLE OF EVALUATIVE PROCESSES: AN EVENT-RELATED POTENTIAL STUDY Ray Johnson Jr.[1,2], Heather Henkell[1,2], Elizabeth J. Simon[1,2], John Zhu[1,2]; [1]Queens College/CUNY, [2]The Graduate Center of CUNY — Evaluative judgments are an important aspect of everyday behavior because they provide a basis for decisions about whether to approach or avoid particular people, places or things. Because little is known about the processes used to make evaluative decisions, we examined how decision complexity affects the nature and timing of cognitive processes used during evaluations. Participants were interviewed to obtain: 1) ratings of their attitudes and beliefs and 2) specific episodes from their autobiographical (AB) memory. In the Attitude condition, subjects classified items as "agree" or "disagree" via a speeded response. In the AB condition, subjects classified episode cues as "you" or "not you." ERPs were recorded from 32 scalp sites. A median-split analysis, based on reaction time, was used to create low- and high-complexity categories. While evidence of episodic retrieval was apparent in both conditions (i.e., presence of a parietal EM effect), its timing relative to the response varied with attitude complexity but not with AB memory retrieval speed. Although responses to low-complexity attitudes were made immediately after retrieval, as is typical in episodic memory studies, the retrieval-response interval was nearly 400 milliseconds for complex attitudes. Increased attitude complexity was also associated with increased pre- and post-response ERP activity over medial frontal scalp that was related to decision complexity and residual response conflict, respectively. ERP activity was present for complex attitudes over dorsolateral frontal scalp in the prolonged retrieval-response interval, which likely reflects processing used to modify the retrieved attitude representation based on current goals and situational information.

D99

THE ROLE OF DECLARATIVE MEMORY IN GAMBLING TASK DECISION MAKING Paul Whitney[1], John Hinson[1], Melissa Mehalick[1]; [1]Washington State University — Performance on the Iowa Gambling Task (IGT) is often used to assess decision making or executive function in clinical and nonclinical settings. The IGT and similar decision making tasks require tracking outcomes of choices over trials. Recent evidence from memory impaired subjects suggests that declarative memory systems may play an important role in IGT decision making. The present study is intended to begin to clarify the role of declarative memory in IGT performance. A critical distinction within the declarative memory literature is memory for an item versus memory for its source. Based on this distinction, we reasoned that good performance on the IGT would depend on source memory, which would be reflected in the ability to bind particular choice outcomes to the deck that produced the outcome. In our study, healthy undergraduate volunteers performed one of several versions of the IGT. After 75 trials we tested item memory (recognition of which outcomes had been seen) and source memory (identification of the deck that produced an outcome). Some subjects passively observed deck choices generated by the computer for the first 75 trials and then made choices actively for the remaining 25 trials. Other subjects made active choices throughout all 100 trials. Item memory performance was unrelated to asymptotic IGT performance, but good source memory was associated with better IGT performance. The data indicate that impairments in IGT performance in patient populations could be due to problems of source memory processing, a temporal lobe function, rather than problems in frontal lobe functions.

D100

IMPLICIT MODULATION OF PREFERENCES FOR ODORS BY EXPLICIT CHOICES IN LONG-TERM MEMORY Géraldine Coppin[1,2], Sylvain Delplanque[1,2], Charlène Fournier[1,2], David Sander[1,2]; [1]Swiss Center for Affective Sciences, University of Geneva, Switzerland, [2]Laboratory for the study of Emotion Elicitation and Expression (E3 Lab), University of Geneva, Switzerland — Several studies have shown that preferences can be strongly modulated by cognitive processes such as decision making and choices. Remarkably, it has been demonstrated that explicit choices, traditionally considered as a reflection of preferences, can in fact create them. However, it is still unclear whether choices can influence preferences of sensory stimuli in an implicit way and if such a modulation is stable over time. This question was addressed here by asking participants to evaluate odors, to choose their preferred odors among pairs, to re-evaluate odors, and to perform an unexpected memory test concerning their choices. After one week, participants were asked to evaluate one more time the odors, and to do choices between pairs similar to those presented the previous week. Results revealed the existence of post-choice preference changes, in the sense of an overvaluation of chosen odors and a devaluation of rejected ones, even when choices were forgotten. These results suggest that chemosensory preferences can be modulated by explicit choices and that such modulation might rely on implicit mechanisms. This finding rules out any explanation of post-choice preference changes in terms of experimental demand and strongly challenges the classical cognitive dissonance reduction account of such preference changes. Moreover, preliminary results showed that this choice-induced preference modulation was still present after one week and the congruence between the choices made the first time and after one week was high. This result invites to further consider the importance of implicit processing in preference acquisition and stability across time.

D101

COOPERATIVITY BETWEEN THE HIPPOCAMPUS AND VENTROMEDIAL PREFRONTAL CORTEX UNDERPINS CONCEPTUAL DECISION MAKING IN HUMANS Dharshan Kumaran[1,2], Jennifer Summerfield[1], Demis Hassabis[1], Eleanor Maguire[1]; [1]Wellcome Trust Centre for Neuroimaging at University College London, London, [2]Stanford University, Palo Alto, California — Concepts lie at the very heart of intelligence, providing organizing principles with which to comprehend the world. Surprisingly little, however, is understood about how concepts are acquired, and influence decision making. To address this question, we developed a paradigm, previously shown to be hippocampal-dependent, where participants received monetary reward by accurately predicting the outcomes associated with individual fractal patterns. Importantly, efficient performance on this task necessitated a conceptual understanding of the task structure, which could be achieved by integrating associative information across related fractal patterns. Using a combination of functional magnetic resonance imaging, and on-line behavioral indices of associative and conceptual learning, we demonstrate that a functionally coupled circuit involving the hippocampus and ventromedial prefrontal cortex (vMPFC) underpins the emergence of conceptual knowledge, and its effect on choice behavior. Critically, activity in the hippocampus alone showed a robust correlation with participants' ability to transfer this knowledge schema to a perceptually novel setting, consistent with a role for this brain region in housing abstract conceptual representations of the task structure. These findings provide evidence that the hippocampus supports conceptual learning through the networking of discrete memories, and reveal the nature of its interaction with downstream valuation modules such as the vMPFC. Our study offers neurobiological insights into the remarkable capacity of humans to discover the conceptual structure of related experiences, and use this knowledge to solve exacting decision problems.

D102

AN INVESTIGATION INTO CATEGORY LEARNING SYSTEM SWITCHING Brian Spiering[1], Carol Seger[1]; [1]Colorado State University — Much recent evidence suggests that human category learning is mediated by multiple systems. The present study investigates participants' ability to switch between these category learning systems. One group of participants were initially trained on three different rule-based categories. At transfer the participants switched between the three rule-based categories every 10-15 trials. A second group of participants followed the same procedure with three different unstructured categories. A third group of participants followed the same procedure with three different information-integration categories. Performance during transfer was higher for both participants switching between the rule-based and unstructured categories compared to participants switching between information-integration categories. The participants switching between information-integration categories performed above chance during transfer. A final group followed the same procedure with one rule-based, one unstructured, and one information-integration categories. Participant performance during transfer was higher during rule-based and unstructured categorization compared to information-integration categorization. Information-integration performance was still greater than chance. Collectively, these results suggest that humans have the ability to rapidly switch between different categorization strategies and subsequent systems.

D103

THE TIME COURSE OF THE VALUE SIGNAL AT THE TIME OF CHOICE Alison Harris[1], Ralph Adolphs[1], Colin C. Camerer[1], Antonio Rangel[1]; [1]California Institute of Technology — It is widely thought that the brain makes decisions by first assigning values to the stimuli under consideration, and then comparing those values to select the best one. While a growing body of work has shown that the medial orbitofrontal and dorsolateral prefrontal cortices play a key role in computing these value signals, the time profile of such signals remains largely unknown. We investigated this question by measuring brain activity using event-related potentials (ERP), while subjects made choices for the right to eat or avoid having to eat a variety of appetitive (e.g., chocolate) and aversive (e.g., baby food) foods at the end of the experiment. We have found that while early (170-250 ms post-stimulus-onset) peaks in the whole brain trial-averaged ERP signal already carry coarse information about the value assigned to the stimuli, neural responses consistent with actual choices only appear beginning at latencies of about 400 ms, primarily over central sensors. In line with previous work on perceptual decision-making, these results not only place decision processes within a set time window, but also provide a first step in characterizing valuation networks in the human brain within the temporal domain.

D104

PASSIVE VALUATION SIGNALS PREDICT POST-HOC CHOICES WITH HIGH-ACCURACY Alec Smith[1], Sean Jezewski[1], B. Douglas Bernheim[2], Colin Camerer[1], Antonio Rangel[1]; [1]California Institute of Technology, [2]Stanford University — An open question in neuroeconomics is whether the brain is constantly evaluating stimuli on the environment, or if it does so only when the value signals are necessary to make a choice. We investigated this question using an fMRI task that has two parts. First, subjects were scanned while they passively viewed images of snack foods. Second, in a surprise post-scanning task they were asked to make real choices between subsets of the snacks shown in the scanner. Using a semi-parametric 'searchlight' procedure we found that the relative BOLD responses to the passive exposure of foods in the anterior cingulate cortex, medial orbitofrontal cortex, dorsolateral prefrontal cortex and portions of the visual cortex predicted with high-accuracy the behavior in the post-scan choice task. The results point to the existence of pervasive valuation in the human brain.

D105

REWARD EXPECTATION MODULATES MOTION DISCRIMINATION PERFORMANCE VIA SETTING THE DECISION-MAKING THRESHOLD AND EVIDENCE-ACCUMULATION-SPEED: A DOPAMINE DEPLETION FMRI STUDY Atsuko Nagano[1], Paul Cisek[2], Andrea Perna[3], Fatemeh Shirdel[1], Marco Leyton[3], Chawki Benkelfat[3], Alain Dagher[1]; [1]Brain Imaging Centre, Montréal Neurological Institute, [2]University de Montréal, [3]Neurology and Neurosurgery, McGill University — We aimed to investigate how dopamine and prior information modulates task-related brain activity during a motion discrimination task. 17 subjects underwent fMRI scans on two different days: once after drinking an amino acid mixture deficient in the dopamine precursors tyrosine and phenylalanine (TPD), and once after drinking a balanced amino acid mixture (BAL). The task involved detecting the motion direction of a random-dot motion stimulus. Prior to each trial, auditory and visual (AV) cues informed whether there would be a monetary reward for a correct decision. We hypothesized that the decision to choose either left or right direction is based on a linear accumulation of evidence from an initial level related to prior probability. A decision is made when evidence reaches a certain threshold. We used the method of Carpenter and Williams (Nature 1995) to estimate a decision-making-threshold index (T-index), and an evidence-accumulation-speed index (A-index). When comparing rewarded to non-rewarded trials, reward expectation was associated with greater activation in extensive cortico-striatal areas (dorsolateral prefrontal, anterior insula, bilateral caudate) and visual areas while observing the random-dots motion stimulus. The former was observed only in the BAL session. T-index difference was positively correlated with activity in the cortico-striatal areas. This suggests that the cortico-striatal system may be involved in setting the decision-making threshold or the initial activity level using cue information, and that this phenomenon is dopamine-dependent. In the BAL session, the A-index difference (rewarded versus non-rewarded trials) was negatively correlated with activation in the inferior parietal sulcus during the response period.

D106

BOLD FMRI ACCUMULATION SIGNALS MODULATE BASED ON THE CONSISTENCY OF EVIDENCE DURING PERCEPTUAL DECISIONS Elisabeth Ploran[1], Joshua Tremel[1], Mark Wheeler[1]; [1]University of Pittsburgh — A previous study (Ploran et al., 2007) has shown that an extended recognition paradigm in which objects are slowly revealed can create accumulating BOLD signals prior to recognition. These effects were observed in select parietal, temporal, and frontal areas as recorded through functional magnetic resonance imaging (fMRI) in humans. However, the quantity of perceptual evidence throughout the trial increased in the original study, limiting interpretation of the data. The current study further examined the accumulation response during perceptual decision-making by maintaining a constant amount of perceptual evidence and sometimes altering the consistency of the evidence. Greyscale objects were presented underneath a checkerboard-like mask with randomly spaced transparencies that changed in sync with each new whole brain image. This produced high quality but consistent limited quantity evidence throughout the trial. In addition, on certain trials the object underneath the mask alternated between two similarly shaped, but not identical objects. This manipulation tested whether accumulation occurs due to attentional needs even without consistent evidence. Despite a consistent limited quantity of evidence, accumulation was still found in bilateral inferior frontal gyrus, bilateral fusiform, and left intraparietal sulcus. Furthermore, changing the picture underneath the mask as an alteration of available evidence decreased the overall magnitude of accumulation, but did not affect sensory or execution processes. These findings support the possibility that accumulating BOLD signals reflect signal integration over time.

D107

A MODEL-FREE APPROACH TO QUANTIFYING REWARD RELATED BOLD RESPONSES IN HUMAN STRIATUM AND MIDBRAIN Eric DeWitt[1], Paul Glimcher[1]; [1]New York University — Recent work in humans and animals has demonstrated that the phasic activity of the midbrain dopamine neuronal activity correlates with the reward prediction error (RPE) of standard reinforcement learning (RL) models. While functional MRI results suggest that the BOLD response is also correlated with RPE in similar tasks, no attempt as been made to to quantitatively describe the BOLD response during RL tasks. We use a novel RL task designed to elicit continuous RPEs and a model-free linear analysis to quantitatively describe the BOLD RPE response as a function of the history of reinforcement received by the subject. Traditional approaches assume highly constrained parametric RL models to locate RPE related BOLD responses. To quantitatively assess the reinforcement related BOLD response we adapt the approach used in Bayer and Glimcher (2004). Using a novel RL task where the optimal policy is known and is approximated by standard RL models, we fit a linear model that predicts subjects' choices from the history of received reinforcement. We then fit a linear model that predicts BOLD response from the history of reinforcement. We then can perform a psychometic-neurometric match of the learning functions. Assuming only linearity in reward history, we can quantitatively test the hypothesis that the BOLD response reflects an RPE signal by comparing the linear weighting to the signature of standard RL learning: an exponential weighting of prior reinforcement. We observe both chosen value and the RPE computations in the anatomically defined nucleus accumbens as predicted by RL theory.

D108

A META-ANALYSIS OF NEURAL REACTIVITY TO FOOD AND SMOKING CUES: DOES OUR BRAIN RESPOND TO FOOD AND DRUG CUES IN THE SAME WAY? Deborah Tang[1,2], B. Hello[1], L. Fellows[1], A. Dagher; [1]Montréal Neurological Institute, Montréal, Canada, [2]McGill University, Montréal, Canada — In healthy individuals, food cues can trigger hunger and feeding behaviour. Likewise, smoking cues can trigger craving and relapse in smokers. Research suggests a common neural response following exposure to food or nicotine cues in rats, suggesting that addictive drugs and natural rewards such as food both elicit one system—the appetitive reward system of the brain. While this has been established in rats, it is not known whether visual food or visual nicotine (smoking) cues elicit a common neural response in humans. Here we investigate the neural network activated by: 1) food versus neutral cues 2) smoking versus neutral cues, by carrying out a meta-analysis of human neuro-imaging studies. PubMed was used to identify all cue-reactivity imaging studies. Thirteen articles were identified for the food meta-analysis and thirteen articles were identified for the smoking meta-analysis. Meta-analyses were carried out using activation likelihood estimation. Food cues were associated with increased BOLD response in the left amygdala, bilateral insula, bilateral orbital frontal cortex (OFC), and the striatum. Smoking cues were associated with increased BOLD response in the same areas. These brain areas are commonly found to be involved learning, memory and motivation. Using meta-analytic techniques to combine a series of studies, we found that food and smoking cues activate comparable brain networks. This suggests that food and drug cues both activate an appetitive system of the brain, and that there is significant overlap in brain regions moderating neural responses to conditioned cues associated with natural and drug rewards.

D109

THE TASK MATTERS: SENSITIVITY OF THE FRN TO FEEDBACK VALENCE IN GAMBLING VERSUS NONGAMBLING PARADIGMS Angela Dzyundzyak[1], Diane Santesso[1], Sidney Segalowitz[1]; [1]Brock University, St. Catharines, ON — The feedback-related negativity (FRN) is a negative-going component in the ERP following the P200 component in response to feedback that shows greater amplitude when the feedback indicates a failure to achieve task goals. Our study examined FRNs with respect to the valence of feedback in two differing tasks: (1) a pure gambling task (PGT) where participants chose between two cards of different magnitude, the valence (win/loss) of their choice being revealed in feedback after the choice; and (2) a speeded response task (SRT) where participants were presented with a cue indicating whether the trial's outcome could potentially involve winning or losing money. Responding quickly enough earned money on "win" trials and avoided losing money on "loss" trials. Slow responses earned nothing on win trials and incurred losing money on loss trials. We compared the FRN's sensitivity to valence of the feedback within and across the tasks. In the PGT task, the FRN was larger to feedback indicating a loss, as expected; however, in the SRT task, the FRN was larger to feedback indicating success. Thus, while the FRN is sensitive to the valence of the feedback, this relationship is modulated by the context. Theoretical implications for understanding the FRN are discussed.

D110

THE EFFECT OF TESTOSTERONE ON BRAIN FUNCTION ASSOCIATED WITH MENTAL ROTATION IN SCHIZOPHRENIA WOMEN Jose Jimenez[1,2], Nadia Lakis[1,2], Adham Mancini-Marië[1,2], Annie Dubé[1,3], Pierre Lalonde[1,2], Marc Lavoie[1,2], Adrianna Mendrek[1,2]; [1]Centre de Recherche Fernand Seguin, Louis-H Lafontaine Hospital, Montréal, Canada, [2]University of Montréal, Montréal, Canada, [3]Concordia University, Montréal, Canada — The effects of testosterone on visuo-spatial abilities have been relatively well documented in healthy individuals. Investigations of the influence of sex steroid hormones on visuo-spatial abilities in schizophrenia patients are lacking. Our objective was to examine the effect of testosterone on performance and brain activation during a mental rotation task (MR) in schizophrenia women (SZ-W) and in healthy women (HW) during two different phases of the menstrual cycle. 15 SZ-W were compared to 15 HW during performance of a classic MR adopted from Sheppard & Meltzer. The subjects were scanned twice, two weeks apart at two stages of their menstrual cycle. Hormonal levels were determined from blood samples taken before each scan. We found that SZ-W demonstrated significantly higher levels of testosterone relative to HW and a significant negative correlation was observed between accuracy and testosterone levels in SZ-W. Also, we found a negative correlation in SZ-W between testosterone and brain function in the first half of the cycle that included the bilateral frontal gyrus, left(L)-cuneus, and right(R)-middle temporal gyrus and in the second half of the cycle in the R-precentral and R-postcentral gyrus. In contrast, a positive correlation was observed between testosterone and cerebral activity in HW in the L-superior temporal cortex and in the L-caudate but only in the second half of the cycle. The results observed in HW are congruent with previous reports in the general population. In SZ-W, the findings suggest that testosterone might have a deleterious effect on performance and brain activation during mental rotation.

D111

FUTURE DECISION-MAKING WITHOUT EPISODIC MENTAL TIME TRAVEL Donna Kwan[1], Carl F. Craver[2], Leonard Green[2], Joel Myerson[2], Pascal Boyer[2], R. Shayna Rosenbaum[1,3]; [1]York University, Toronto, Canada, [2]Washington University in St. Louis, MO, [3]Rotman Research Institute, Baycrest, Toronto, Canada — Both neuroimaging and patient studies show that the ability to remember events from one's past (episodic memory) and the ability to envision events in one's future (episodic future thinking) are tightly interconnected: Both activities recruit similar brain regions, and the loss of one ability due to an injury is typically accompanied by loss of the other ability. However, it is unclear if all aspects of future-oriented thought are lost in the event of such injury, or whether some aspects including future decision-making are spared. The present study investigates whether lost ability for mental time travel precludes the ability to consider the future in the context of economic decision-making. To address this question, we tested an episodic amnesic person and matched controls on an established behavioural economics task (temporal discounting) that gauges participants' ability to forgo smaller short-term gains for larger long-term gains. Performance is taken to reflect one's evaluation of future rewards and how value decreases as a function of delay. Variability in performance was assessed by having the patient and controls complete the task several times over a period of approximately one week. Results show that despite lost ability for mental time travel (i.e. remembering his past or envisioning his future) the episodic amnesic person nonetheless evaluated future outcomes in a fashion similar to controls. Variability in his performance across testing occasions did not differ from the inter-subject variability of controls. These results indicate that some types of future-oriented thought such as decision-making do not require mental time travel.

D112

RISKY DECISION-MAKING IN YOUNG CHILDREN ACTIVATES PREFRONTAL AND POSTERIOR PARIETAL REGIONS David Paulsen[1,2,3], McKell Carter[2,3], Michael Platt[2,3,5], Scott Huettel[1,2,3,4], Elizabeth Brannon[1,2,3]; [1]Psychology & Neuroscience, Duke University, [2]Center for Cognitive Neuroscience, Duke University, [3]Center for Neuroeconomic Studies, Duke University, [4]Brain Imaging and Analysis Center, Duke University, [5]Neurobiology, Duke University — Previous imaging studies with adult participants have found specific regions of prefrontal cortex (PFC) and posterior parietal cortex to be associated with risky decision-making. However, studies of risky decision-making in children have been relatively few in number, with little yet known about individual differences. Young children (6-7 years old) made decisions about probabilistic and certain rewards (i.e., tokens that could be later traded for toys) while event-related functional magnetic resonance imaging data were acquired. On Sure Bet trials, participants chose between two certain options that differed in value, whereas the Gamble trials involved a choice between two options with similar expected value but different levels of Risk. For each participant, we calculated economic risk preferences that were used as covariates in the general linear model of the imaging data analysis. Activation in orbitofrontal cortex, dorsolateral PFC, and medial PFC regions was negatively correlated with risk preference during active decision making. Posterior parietal cortex was also active when children made decisions and was more active during Gamble than Sure Bet trials. Furthermore, winning and losing outcomes elicited activation in regions associated with reward and executive function. Together, these results indicate that the neural systems involved with adult decision-making are already present in young children, and that individual differences in children's risk preferences shape the activation of these regions.

D113

DECISION-MAKING IN OLDER ADULTS: SOMETIMES OLDER IS WISER Darrell Worthy[1], Tanya Chotibut[1], Jennifer L. Pacheco[1], W. Todd Maddox[1]; [1]University of Texas at Austin — Previous work in our lab demonstrated that younger adults were more efficient than older adults at exploiting short-term gains in a decision-making task. Experiment 1 of the current study examined the performance of healthy younger (aged 18-24) and older adults (aged 61-87) in the same decision-making task but one that required efficient exploration of options with lower expected values for optimal long-term performance. The results from Experiment 1 indicated that older adults are more willing to sample from options with lower expected values which led to better overall decision–making performance. Experiment 2 examined the performance of younger and older adults in a dynamic decision making task that required exploring long-term increasing options that had worse short term gains, but that eventually yielded higher rewards. Preliminary results from Experiment 2 indicate that older adults are more willing to sample the long-term increasing option earlier in the task than the Younger adults. Within the Older adult groups in both Experiments there was a positive relationship between age and long-term advantageous choices. These results coincide with behavioral and neuroimaging data that suggest that older adults may develop less stringent stimulus-reward relationships , possibly due to age-related decline in the striatum and areas of the prefrontal cortex (Mell et al., 2005; Schott et al., 2007; Samanez-Larkin et al., 2007). While, under some conditions this leads to poorer decision-making in older adults, under other conditions (e.g., when performance was contingent on full exploration of the decision-space), older adults outperformed their younger counterparts.

D114

VENTROMEDIAL FRONTAL LESIONS DISRUPT THE OUTCOME, BUT NOT THE TIMING, OF SIMPLE PREFERENCE JUDGMENTS Alexandre Henri-Bhargava[1,2], Alison C. Simioni[3,4], Lesley K. Fellows[3,4]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest, [3]McGill University, [4]Montréal Neurological Institute — Several lines of evidence suggest that the ventromedial frontal lobe (VMF) represents the economic value of options. Work from our lab has shown that patients with lesions to VMF are less consistent than controls in making simple preference judgments. Deliberation time in such decisions is known to relate to the "distance" between the values of the options under consideration: Items of similar value take longer to choose between. We investigated whether this relationship would hold true in patients with VMF damage. Sixteen VMF and 10 non-VMF frontal injured participants were recruited from databases at McGill University and the University of Pennsylvania. These were compared to 24 demographically-matched healthy controls. A preference task was administered requiring subjects to indicate their preference for 12 stimuli (pictures of puppies) presented two at a time, in all possible combinations. Participants were asked to make their preference decisions accurately, but as quickly as possible. Choices were analyzed for internal consistency and reaction time was recorded as a function of the "value distance" between the choices presented at each trial, inferred from the overall pattern of choices. VMF patients were significantly more erratic than both non-VMF injured and healthy control participants in their judgments. There was a non-significant trend towards slower decisions in the VMF group, but the relationship between decision time and value distance was preserved. VMF damage thus leads to impaired decision-making without equivocation. This may be a useful starting point for understanding the link between poor judgment and poor insight in such patients.

D115

HOW POST-DECISION CONFIDENCE MODULATES PERFORMANCE MONITORING: EVIDENCE FROM THE FEEDBACK-EVOKED POTENTIALS

Karim N'Diaye[1,2,3], Iris Knierim[1,2,3], Valentin Wyart[1,2,3], Catherine Tallon-Baudry[1,2,3]; [1]Université Pierre et Marie Curie-Paris 6, Centre de Recherche de l'Institut du Cerveau et de la Moelle epiniere, UMR-S975, Paris, France, [2]Inserm, U975, Paris, France, [3]Cnrs, UMR 7225, Paris, France — Investigations in animal neurophysiology have recently identified neural correlates of post-decisional confidence, however human data on this topic remain scant. In particular, it is still unclear how subjective confidence may be used as a internal source of information on one's performance and interact with external sources, such as feedback. We therefore studied how feedback-evoked potentials would be modulated by the degree of subjective confidence while healthy human participants were performing a visual numerosity judgment task. On each trial, after giving their response on the number of dots in an array, participants rated their subjective confidence on a scale; then a feedback was displayed indicating whether they were correct or not on their numerosity judgment. By mean of online adjustment, objective performance for each individual was maintained constant. This allowed us to obtain enough trials with relatively high and low confidence ratings for both correct and incorrect responses for computing event-related potentials from the EEG. As expected, the difference wave between potentials evoked by incorrect minus correct feedback revealed a feedback-related negative potential around 300ms after feedback onset, the feedback-negativity. Interestingly, this response was located both over parietal and frontal regions and its amplitude was significantly increased in high-confidence trials. The topography of this modulation showed a right frontal peak occuring slightly later in time (~320ms) revealing a significant interaction between confidence and feedback. These data shed light on the time-course of performance monitoring showing that external information is first processed and then integrated with internal indices, such as subjective confidence.

D116

VISUAL ATTENTION GUIDES THE COMPARISON OF VALUE IN MULTI-ITEM CHOICE

Ian Krajbich[1], Johannes Pulst-Korenberg[1], Antonio Rangel[1]; [1]California Institute of Technology — Most organisms make choices by first assigning values to the options under consideration and then comparing them. However, little is know about how values are compared or about the role of attention in this process. Here we propose a computational model of how visual attention guides the comparison process in choices between any number of items and test it using eye-tracking. The model is a variant of the race-to-barrier models of perceptual decision-making with an important modification: visual attention guides the path of integration of the relative value signal. We test the model using a 3-item choice task, where hungry subjects make choices by looking at pictures of snacks. The results show that visual attention plays a strong role in the comparison of values even though the pattern of fixations is largely independent of the underlying values. This leads to various choice biases that result in systematic suboptimal decision making.

D117

WHEN YOU KEEP CHANGING YOUR MIND: THE NEURAL BASIS OF PREFERENCE REVERSALS

Jessica Stump[1], Joseph Kable[1]; [1]University of Pennsylvania — Systematic inconsistencies in people's choices provide a central challenge to rational choice theories. One example of such an inconsistency is the task-induced preference reversal, in which people choose one option over another, but then bid a higher price for the non-chosen option. Such inconsistencies have been attributed either to context-dependent changes in valuation, or to mistakes caused by simplifying heuristics. We gathered neuroimaging data to inform the debate about the cause of preference reversals. Preference reversals were elicited using a risky gamble paradigm in 20 subjects undergoing fMRI. Given the choice between a gamble with a high probability of winning a small amount of money (termed the P-bet, e.g., 84% chance of $20) and a gamble with a low probability of winning a greater amount (termed the $-bet, e.g., 24% chance of $70), subjects chose the P-bet 70% of the time. However, when asked to provide separate bids for the paired gambles, subjects assigned a higher dollar value to the $-bet 64% of the time. Preliminary analyses suggest that during bids but not choices, anterior dorsolateral prefrontal regions exhibited greater activity for $-bets compared to P-bets. Furthermore, the size of this effect was correlated across subjects with the number of preference reversals. To the extent that dorsolateral prefrontal cortex has been implicated in heuristic- or rule-based decision-making, these results support the argument that task-induced preference reversals arise due to a heuristic that leads to overbidding on $-bets.

D118

THE ERP STUDY IN A MODIFIED IGT

Hui-kuan Chung[1], Nai-Shing Yen[1,2], I-Chen Chou[1], Chang-Hao Kao[1], Tsung-Han Yang[1], Bie-Shuein Chu[1]; [1]National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan — The present study used a modified Iowa Gambling Task (IGT-E) and recorded event-related potential (ERP) to investigate the brain mechanisms. The IGT-E presented gain, loss and accumulation of money sequentially. The feedback-related negativity (FRN) is the ERP component reflecting the negative feedback and prediction conflict. Thus, FRN after gain feedback, loss feedback, and accumulation of money were analyzed. The behavioral data revealed the same result as Bechara's study (Bechara et al., 1994). Moreover, in loss condition, there were main effects in expected value and in risk level. The risk level is defined as the frequency of loss and the amount of loss on each trial. In specific, the high risk deck is the one with lower frequency but greater amount of loss. The higher FRN was observed in the deck with positive expected value than the deck with negative expected value. In addition, the higher FRN was observed in the deck with high risk level than with low risk level. Further analysis showed that the higher FRN was induced in the deck with positive expected value and high risk level than the other decks. This result consisted with the past studies for prediction conflict. The deck with positive expected value is expected to be good, and therefore a big loss is unexpected, which resulted in higher FRN. However, no significant effect was found on FRN in gain condition and accumulation of money condition. Compared with three different brain regions, the FRN was higher in Fz than in Cz and Pz.

D119

DISSOCIATED DECISION PROCESSES UNDER TIME PRESSURE IN THE IOWA GAMBLING TASK

I-Chen Chou[1], Nai-Shing Yen[1,2], Chang-Hao Kao[1], Hui-Kuan Chung[1], Tsung-Han Yang[1]; [1]National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan — The Iowa Gambling Task is widely used to investigate the relationships between emotions and decision making in behavioral and neuropsychological research. A different concept is proposed that the performance in the IGT reflects two dissociated processes: analytic reasoning process and heuristic judgments process. The analytic reasoning process tracks the long-term payoff of each option, while the heuristic judgments process is sensitive to the frequency of losses under risk. There were two variables manipulated in the present study, namely, the phase of the card selection (learning and decision phases) and the time pressure. A modified IGT (IGT-M) is used in this experiment. In IGT-M, all participants took part in two phases (the learning and the decision phases). After the learning phase with feedback display, participants would perform a ''blind'' card selection phase without receiving any feedback in the decision phase. The time pressure is design to enhance participants ' cognitive loading. Each of them was randomly assigned to the time pressure condition or no time pressure condition. The result revealed that the first learning phase required central cognitive resources to assess long-term payoff. Moreover, under the time pressure, participant made more risk decisions in the decision phase.

D120

NEURAL SUBSTRATE OF ANTICIPATORY TIME PERCEPTION AND TIME DISCOUNTING Li Jiang[1], B. Kyu Kim[1], Gal Zauberman[1], Joseph W. Kable[1]; [1]University of Pennsylvania — People often face decisions, such as saving for retirement, that involve choosing between payoffs that occur at different points in time. Such decisions are called intertemporal choices. Previous research has suggested that the subjective perception of future time intervals might explain anomalies in intertemporal choice. However, while the neural substrates of perceiving experienced time have been well studied, we know little about the neural mechanisms involved in judging future time, or how these mechanisms might relate to those involved in intertemporal choice. We scanned subjects with fMRI while they performed anticipatory time perception and intertemporal choice tasks. In the anticipatory time perception task, we asked subjects to mark on a horizontal line their subjective sense of a future duration, from "very short" to "very long." In intertemporal choice, we asked subjects what amount of money now would be subjectively equivalent to receiving $75 dollars after a certain delay. Consistent with previous work, we found that anticipatory time perception follows a power law and that intertemporal choice follows hyperbolic discounting. We also observed that brain activity in right dorsolateral prefrontal cortex was correlated with each person's subjective percept of future durations, even after accounting for its relationship with objective duration. These regions do not overlap with those that track the subjective value of future rewards in the intertemporal choice task, but they do include regions previously implicated in experienced time perception. Ongoing work is investigating interactions between brain regions involved in anticipatory time perception and in intertemporal decision-making.

D121

TRANSCRANIAL DIRECT CURRENT STIMULATION ALTERING RISK PREFERENCES Ikuya Nomura[1], Haruaki Fukuda[1], Kazuhiro Ueda[1]; [1]The University of Tokyo — We human are frequently urged to make decision which goes with risk assessment. Some always takes the risky choices while others always or at least sometimes avert them. This occurs just because our utility functions which determine our attitude against risks differs between each other. Previous studies have shown that concurrent anodal transcranial direct current stimulation (tDCS) over the right dorsolateral prefrontal cortex(DLPFC) with the cathodal tDCS over the left DLPFC reduces the choice of high risk prospects at some risk tasks. Here, our study's aim is to indicate that tDCS does not only influence a ratio of risky choices at a specific risk task, but it affects one's utility function itself. To elicit one's utility function, we used Abdellaoui's method which asks a subject repeatedly to choose a lottery between two thar differ in risk. Subjects received right anodal/ left cathodal tDCS, left anodal/ right cathodal tDCS, sham stimulation and we elicited their utility functions at each stimulation. As predicted, subject's utility function during receiving right anodal/ left cathodal tDCS was more risk aversive than that during receiving left anodal/ right cathodal tDCS.

D122

A NOVEL OUTCOME-OVEREXPECTATION TASK IN HUMANS AS A COGNITIVE ANALOG OF PAVLOVIAN US-OVEREXPECTATION Dale Swanton[1], Geoffrey Schoenbaum[2], Mark Gluck[1]; [1]Center for Molecular and Behavioral Neuroscience, Rutgers University, Newark, [2]University of Maryland School of Medicine — We present a novel outcome-overexpectation task and discuss data from healthy controls. Our task is based on the Pavlovian paradigm of US-Overexpectation in which a CS loses some of its associative strength due to repeated pairings with another CS in compound, following prior training to both CSs independently. This phenomenon has been explained in animal learning by the error-correcting principle of the Rescorla-Wagner model (Rescorla & Wagner, 1972), which argues that the negative prediction error caused by a violation of overexpectation will reduce the associative strength of the individual stimuli. Overexpectation has been observed frequently in the animal literature (Kehoe & White, 2004; Takahashi et al., 2009), but to a lesser extent in humans (Collins & Shanks, 2006). Here, participants were trained that various energy drinks (CSs) predicted how far a fictional soccer player kicked a ball. A one-way analysis of variance revealed a significant weakening of response to the critical test cue relative to control cues ($F [2, 26] = 6.965$, $p = .004$), indicating that overexpectation had occurred. The orbitofrontal cortex (OFC) has been strongly implicated in animal studies of US-overexpectation (Schoenbaum et al., 2003; Takahashi et al., 2009), leading to the possible use of such a task in humans as a tool for studying neurological and psychiatric disorders that involve the OFC.

D123

TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS) FACILITATES DECISION MAKING IN A PROBABILITY GUESSING TASK David Hecht[1,2], Vincent Walsh[2], Michal Lavidor[1]; [1]University of Hull, UK, [2]University College London, UK — In a random sequence of binary events where one alternative occurs more often that the other, humans tend to guess which of the two alternatives will occur next by trying to match the frequencies of previous occurrences. Based on split-brain and unilateral damaged patients it has been proposed that the left hemisphere (LH) tends to match the frequencies, while the right hemisphere (RH) tends towards maximizing and always choosing the most frequent alternative. The current study used transcranial direct current stimulation (tDCS) to test this hemispheric asymmetry hypothesis by stimulating the dorsolateral prefrontal cortex of each hemisphere and simultaneously inhibiting the corresponding region in the other hemisphere, while participants were engaged in a probability guessing task. Results showed no difference in strategy between the three groups (RH anodal/LH cathodal, LH anodal/RH cathodal, no stimulation) as participants always tended to match the frequencies of the two alternatives. However, when anodal tDCS was applied to the LH and cathodal tDCS applied to the RH, we observed a clear and steady reduction, over the blocks of trials, in response times for selecting the most-frequent option. This finding is in line with previous evidence on the involvement of the LH in probabilistic learning and reasoning. In addition, it may also reflect the LH relative disinhibitory inclination and its greater role in decision processes, as well as its propensity for overinterpretation and premature conclusions based on insufficient evidence.

D124

THE SCARCITY HEURISTIC IMPACTS ERROR EVALUATION WITHIN MEDIAL-FRONTAL CORTEX Boaz Y. Saffer[1], Olav E. Krigolson[1], Todd C. Handy; [1]The University of British Columbia (UBC) — Humans utilize heuristics – rules of thumb – to simplify the decision making process. For instance, the scarcity heuristic is an assumption that scarce resources are more inherently valuable than frequent resources, even in the absence of information affirming the validity of this assumption. Here, we predicted that error evaluation within medial-frontal cortex would be impacted by the scarcity heuristic. Specifically, we predicted that the amplitude of the error-related negativity (ERN), a component of the event-related brain potential (ERP) thought to reflect a reinforcement learning prediction error, would be impacted by stimulus probability. Participants played a game in which they were presented with twenty-five gambles on each trial. The twenty-five gambles were colour coded into an infrequent and a frequent subset of gambles. On each trial participants picked six of the twenty-five available gambles and were provided with feedback about the results of each gamble. Participants were given no information about the relationship between the colour, frequency, and results of the gambles. Unbeknownst to participants, feedback for each gamble was random. An analysis of the feedback averaged ERP waveforms revealed an ERN for both frequent and infrequent gambles. Further, the amplitude of the ERN for infrequent gambles was greater than that for frequent gambles – even though the actual number of gambles in each category (frequent, infrequent) was the same. In sum, our results suggest that error evaluation within medial-frontal cortex does not rely solely on reinforcement learning principles, but instead also takes into account heuristics.

D125

DECISION-MAKING GUIDED BY THE INFERRED VALUE OF UNSAMPLED STIMULI Karin Cox[1,2], Julie Fiez[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition — Lockhart et al. (1963) asked whether monkeys who had developed a discrimination learning set (i.e., achieved ceiling accuracy on all but the initial trial of novel discriminations) could learn a second task that required inferences regarding the value of initially-unsampled objects. In the new task, each sampled Trial 1 object was replaced with a novel object (with the same reward value) on Trial 2. The monkeys did not exceed chance performance on this task. We asked whether humans, provided with no verbal clues, would fare better. Ten undergraduates (18-20 y, 5 males) completed a modified version of the Lockhart et al. (1963) experiment, consisting of training on deterministic pattern discrimination followed by the introduction of the replacement manipulation. Both the training and replacement phases were terminated following attainment of 90% Trial 2 accuracy within a 20-problem block or completion of 25 total blocks. Criterion performance was achieved by 9/10 subjects, although the number of blocks required to reach criterion was surprisingly variable for the replacement phase (range = 1 - 20, mean = 8.33). Subjects' difficulty with this task may have been largely driven by problems in which a Trial 1 rewarded stimulus was replaced; these problems yielded less accurate performance relative to those in which a nonrewarded stimulus was replaced ($p = 0.04$). Our findings confirm that humans can take advantage of the inferred value of an unsampled stimulus, but their tendency to do so may be subject to attentional biases and individual differences in strategy use.

D126

PREFERENCE FOR POSITIVE VERSUS NEGATIVE-FEEDBACK LEARNING IN PARKINSON'S PATIENTS AT RISK FOR IMPULSE CONTROL DISORDERS Szabolcs Keri[1], Rachel Jonas[2], Mark A. Gluck[2]; [1]Semmelweis University, Hungary, [2]Rutgers University, Newark — Parkinson's patients who subsequently developed impulse control disorders (ICDs) such as compulsive gambling or hypersexuality showed a higher than normal preference for learning from positive feedback in a probabilistic categorization task when first put on dopamine agonist treatment, as compared to other Parkinson's patients who did not develop ICDs or to matched healthy controls. These patients were a subset of the patients originally tested in the study reported last year as Bodi et al. (2009, Brain) in which young medication-naive patients showed an impairment in learning from positive-feedback while those just recently placed on dopamine agonists showed an impairment in learning from negative-feedback. The new longitudinal follow-up data suggests that susceptibility to ICDs may result from a dopamine-agonist induced hypersensitivity in processing positive feedback and other rewards.

D127

THE INFLUENCE OF ACUTE STRESS ON REWARD PROCESSING AND DECISION MAKING Anthony J. Porcelli[1], Mauricio R. Delgado[1]; [1]Rutgers University — Research suggests stress exposure modulates cognition behaviorally (e.g., Patil et al., 1995) and neurally (e.g., Arnsten & Goldman-Rakic, 1998). Less is known about stress-related modulation of the neural substrates of human decision making, however, a critical link to learning to cope with maladaptive behaviors (e.g., drug addiction). The goal of this study was to probe the influence of acute stress on financial decision-making in humans. In this experiment participants engaged in a gambling task during fMRI scanning under conditions of acute stress (i.e., exposure to extreme cold) or no stress (i.e., a room temperature control). They made binary choices between gambles at varying levels of perceived risk, presented separately in either the gain (e.g., a 20% chance of winning $3.00 vs. an 80% chance of winning $0.75) or loss (e.g., a 20% chance of losing $3.00 vs. an 80% chance of losing $0.75) domains. Participants' choices were deemed "risky" or "conservative" based on probability of success. Salivary cortisol data were acquired; after acute stress exposure cortisol levels were elevated. Behaviorally, participants' risk-taking increased under acute stress, particularly in the loss domain. At decision, acute stress modulated BOLD responses with respect to decision domain and decision strategy in brain regions such as the anterior cingulate, orbitofrontal cortex, striatum, and amygdala. In addition, reward-related processing at the level of feedback in the striatum was diminished under acute stress, suggesting that stress exposure influences reward processing at the neural level both while making decisions and receiving feedback on past decisions.

D128

FINANCIAL EDUCATION REDUCES DELAY DISCOUNTING Nicole Senecal[1], Joseph W. Kable[1]; [1]University of Pennsylvania — When making decisions that involve tradeoffs between the quality and timing of desirable outcomes, people consistently discount the value of future outcomes. This discounting process is often measured in the laboratory by asking subjects to choose between a smaller amount of money available immediately and a larger amount available after a delay. Subjects who discount highly on this task are more likely to exhibit problem behaviors such as drug abuse and pathological gambling, and this task has been widely used in neuroscience studies of decision-making. However, the degree of discounting observed on this task is extremely puzzling from an economic viewpoint. Since subjects are making decisions about money, the normative economic strategy is to only turn down rates of return from the experimenter that are lower than rates available on the market. However, all studies of temporal discounting cite discount rates that are significantly higher. Here we ask whether subjects discount to such a degree because they are simply unaware of the normative economic argument. Subjects read a "financial education guide," which explicitly described the optimal decision strategy. Immediately after reading the guide, discount rates decreased by 80%. After one month, subjects' discount rates had increased, but were still significantly lower than before subjects had read the guide. This demonstrates that a simple educational intervention can have a long-lasting effect on decision-making. Given this strong effect, this paradigm should prove useful for studying neural mechanisms by which education can change behavior.

D129

DIFFERENTIAL NEURAL RESPONSES TO EXPECTED VALUE AND UNCERTAINTY IN A MIXED-GAMBLE TASK AS REVEALED BY FUNCTIONAL MRI Catherine L. Jones[1,2], Ludovico Minati[1], Neil A. Harrison[1], Jamie Ward[2], Hugo D. Critchley[1]; [1]Clinical Imaging Sciences Centre, Brighton and Sussex Medical School, Brighton UK, [2]University of Sussex, Brighton UK — In mixed-gamble tasks, decisions are driven by integration of available information into abstract representations such as expected value, risk and uncertainty. Previous work has demonstrated that this process involves an extended network of cortical and subcortical regions. Here, we explored the regional specificity of neural responses to varying levels of expected value and uncertainty, computed from proposed gambles characterised by winning probability, potential loss and potential gain. Subjects were not given any feedback. Region-of-interest analyses were performed for cortical and subcortical regions using expected value and uncertainty as factors. Percentage of bets increased with expected value and was not influenced by uncertainty. A hierarchical ANOVA demonstrated differential regional responses to expected value and uncertainty. While no activation effects were observed for the posterior insula, there were left-lateralised responses to expected value and uncertainty in the anterior insula. No significant responses were observed for the amygdala and pallidus-putamen complex. Conversely, the caudate and anterior cingulate cortex responded to both expected value and uncertainty, while the dorsal and ventral prefrontal cortices differentially responded to uncertainty only. While activation in the anterior insula and cingulate followed a non-linear pattern, engagement of the caudate nucleus increased monotonically with expected value. All uncertainty-sensitive regions displayed greater activation for low uncertainty. No interactions between the two factors were observed for any region. This study extends previous neuroimaging and lesion literature in demonstrating that the distributed representations of expected value and uncertainty supporting decision-making are differentially expressed in activation of the insula, basal ganglia and prefrontal circuits.

Language: Development & Aging

D130

BRAIN STRUCTURAL DIFFERENCES BETWEEN AUTISM SPECTRUM YOUNG ADULTS WITH AND WITHOUT DELAYED SPEECH ACQUISITION

Krista Hyde[1], Fabienne Samson[2], Alan Evans[1], Laurent Mottron[2]; [1]McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University, [2]Centre d'Excellence en Troubles Envahissants du Développement de l'Université de Montréal (CETEDUM) — Autism exists across a wide spectrum and there is debate as to whether autism spectrum individuals with average IQ and typical speech onset (''Asperger's syndrome'') should be considered a distinct subgroup from those with delayed speech onset ("Autism"). Here, we investigated whether cortical thickness (CT) in young adults with autism can be distinguished based on whether they have typical or delayed speech onset. Autism spectrum adults with delayed speech onset had increased CT relative to the autism group with typical speech onset in several cortical areas (bilateral cingulate and tranverse temporal gyri, left insula, superior marginal, occipital and frontal gyri), but decreased CT in only the left postcentral and fusiform gyri. One possibility is that these CT differences are related to differences in the age of speech onset (and less likely due to differences in core symptoms of autism, since diagnostic measures were matched between autism spectrum groups). Indeed, age of first phrase was correlated with CT in several of these above brain areas. Consistent with previous findings (Hyde et al., 2009), CT differences were also found between the autism speech delay group and typically developing controls (matched in age, gender, IQ) in distributed cortical areas, however no CT differences were found between the autism group with typical speech onset and controls. The novel CT differences found here between autism spectrum adults with typical versus delayed speech onset suggest that history of language acquisition may be a marker that distinguishes heterogeneous brain phenotypes within the autism spectrum.

Language: Other

E2

EVENT-RELATED POTENTIAL RESPONSES TO GRAMMATICALITY VIOLATIONS INVOLVING VERBS: A POSSIBLE INDEX OF INCREASING SECOND-LANGUAGE PROFICIENCY J. D. Purdy[1], Karen Froud[1]; [1]Teachers College, Columbia University — Increased second-language (L2) proficiency is associated with a shift from explicit to implicit processing; however, the neural underpinnings are little understood. Furthermore, it is known that unaccusative verbs cause persistent difficulties in L2 learning. We examined event-related potential (ERP) responses to grammatical and ungrammatical sentences involving passive, unergative and unaccusative verbs, in native and L2 English speakers, to investigate whether neural responses changed with increasing proficiency. Native English speakers and three groups of Chinese learners of English at different proficiency levels (low, mid, high) were shown grammatical sentences containing passive, unergative, or unaccusative verbs, and ungrammatical sentences containing incorrectly passivized unaccusative and unergative verbs. Concurrently obtained high-density electroencephalogram (EEG) recordings were segmented at verb onset, and averaged for each condition. No systematic difference between the verb types was observed for the native speakers; however, the three learner groups all showed different responses to the verb manipulation. Native speakers revealed a left anterior negativity (LAN/N280) to ungrammatical conditions, followed by a ramplike negativity (the N400/700, previously identified as an index of expectancy with respect to phrasal heads). However, the three learner groups showed an N180 peak over parietal sensors bilaterally, greatest in amplitude and duration for low-proficiency learners and attenuated for middle and high proficiency learners. N180 is associated with visual working memory, and our findings therefore accord with suggestions that non-native speakers recruit non-linguistic mechanisms for L2 processing. We hypothesize that N180 attenuation, together with a shift towards anterior and left-lateralized processing, may provide an index of increased L2 proficiency.

E3

ONLINE PROCESSING OF DISCOURSE-LEVEL CONGRUENCE AND LEXICAL ASSOCIATIVE PRIMING IN SCHIZOPHRENIA: AN ERP STUDY Megan A. Boudewyn[1], Tamara Y. Swaab[1,2], Ann Kring[3], Steven Luck[1,2], George R. Mangun[1], J. Daniel Ragland[4], Charan Ranganath[1,5], Cameron S. Carter[1,5,6]; [1]University of California, Davis, [2]Center for Mind and Brain, UC Davis, [3]University of California, Berkeley, [4]UC Davis Medical School, [5]Center for Neuroscience, UC Davis, [6]Imaging Research Center, UC Davis — This study used ERPs to test whether schizophrenia patients have difficulty in exerting control over the process maintaining language context to constrain word meanings during spoken language comprehension. We examined the interplay of lexical association and discourse-level congruence in schizophrenic patients and control participants. Participants listened to three-sentence passages containing associative word pairs culled from existing norms. The terminal word in the third sentence varied in overall discourse congruence and lexical association with a preceding prime word; e.g., "Luckily Ben had picked up some salt and pepper/basil", preceded either by a context in which Ben was preparing marinara sauce (discourse congruent) or dealing with an icy walkway (discourse incongruent). Previous studies of schizophrenia patients have related language impairments to difficulties in processing linguistic context or to increased effects of lexical priming ("hyperpriming"). Our study directly assessed effects of discourse congruity and lexical priming in the same patients using the N400, an ERP component that is sensitive to semantic aspects of the input. In contrast to controls, schizophrenia patients only showed N400 effects of lexical association for words that were also congruent with the overall context, but no effects of discourse context or association in any of the other comparisons. These findings show that 1) in contrast to controls, schizophrenics show no immediate effects of discourse congruence on lexical-semantic processing of a critical word, suggesting difficulties with maintaining the overall discourse representation, and 2) since priming was not found for incongruent discourses, hyperpriming alone cannot account for language problems in schizophrenia.

E4

ERP EVIDENCE FOR ATTENUATED AUDITORY RECOVERY CYCLES IN CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT (SLI) Courtney Stevens[1], David Paulsen[2], Leila Mitsunaga[1], Alia Yasen[1], Helen Neville[3]; [1]Willamette University, [2]Duke University, [3]University of Oregon — Previous research suggests that low-level auditory processing deficits may play a role in the language difficulties experienced by at least some children with specific language impairment (SLI). The goal of the present study was to compare auditory recovery cycles, indexed by increases in the neural response at slower rates of stimulus presentation, in 12 children with SLI and 12 matched controls. Event-related brain potentials (ERPs) were recorded to 100 msec linguistic and nonlinguistic probe stimuli embedded in a complex acoustic environment. The stimuli were presented at interstimulus intervals of 200, 500, or 1000 msec. Results indicated that both groups of children showed a similar broad positivity from ~100-250 msec in response to the probe stimuli. However, the two groups of children showed different effects of variation in the interstimulus interval on the amplitude of the neural response, suggesting greater neural recovery in typically developing children. These effects generalized to both linguistic and nonlinguistic probe stimuli. Taken together, these data suggest that deficits in the neural systems mediating low-level aspects of auditory processing, including auditory recovery cycles, may be part of the profile of deficits among at least some children with specific language impairment.

E5

NEUROPHYSIOLOGICAL INDICES OF CATEGORICAL PERCEPTION OF CHINESE LEXICAL TONES: ACOUSTIC AND PHONOLOGICAL INFORMATION IS PROCESSED IN PARALLEL Linjun Zhang[3,1], Jie Xi[1,2], Hua Shu[1], Yang Zhang[4], Ping Li[5]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [2]State Key Laboratory of Brain and Cognitive Science, Institute of Psychology, Chinese Academy of Sciences, Beijing, China, [3]College of Chinese Studies, Beijing

Language and Culture University, Beijing, China, [4]Center for Neurobehavioral Development, University of Minnesota, [5]Center for Language Science, Pennsylvania State University — The present study investigated the neurophysiological correlates of categorical perception of Chinese lexical tones in sixteen adult native speakers of Mandarin Chinese. Two sets of stimuli were constructed for this experiment: speech and nonspeech. The speech stimuli were Chinese monosyllables /pa/ that differed in their lexical tones (the high rising tone, Tone 2 and the falling tone, Tone 4). Based on the behavioral test results, the standard stimulus, a cross-category deviant and a within-category deviant were chosen for the ERP oddball paradigm experiment. The nonspeech stimuli were harmonic tones with the same pitch, amplitude, and duration parameters as the speech stimuli. The results showed that the Mismatch Negativity (MMN) response was enhanced by a change across the category boundary relative to equivalent physical change within the category boundary. The MMN enhancement was dominant in the left frontal-central recording sites, suggesting linguistic processing of phonological representations of the tonal categories. Furthermore, MMN enhancement was observed for an acoustic control condition using non-speech stimuli, which indicated transfer of lexical tone knowledge to the perception of non-speech signals. These data collectively demonstrate that acoustic and phonological information is processed in parallel at the MMN time window for the perception of lexical tones.

E6

IS THE VOLUME OF FRONTAL GYRI A PREDICTOR OF VERBAL FLUENCY, OR IS FLUENCY A PREDICTOR OF FUTURE FRONTAL ATROPHY? Olof Lindberg[1], Sari Karlsson[3], Carl-Henrik Ehrenkrona[1], Leif A. Svensson[2], Eva Örndahl[2], Linnea Engström[1], Qiu Chengxuan[3], Yi Zhang[1], Laura Fratiglioni[3], Lars-Olof Wahlund[1], Lars Bäckman[3]; [1]Health Care Science and Society, Karolinska Institut, Stockholm, Sweden, [2]Karolinska university hospital, Huddinge, Stockholm, Sweden, [3]Aging Research Centre (ARC), Karolinska institute. — Verbal fluency is traditionally used to investigate frontal lobe language functions. We investigated the relationship between verbal fluency and total volume of the superior and middle frontal gyrus in 318 healthy elderly subjects between 60-93 years of age. Frontal volumes were measured manually at two time points. Scan intervals were approximately 6 years for younger participants (60-72 years) and 3 years for older participants (+ 72 years). Verbal fluency was measured at the time of the baseline scan. We found no relationship between verbal fluency and total volume of the frontal gyri at baseline. Interestingly, however, verbal fluency at baseline was linked to frontal volumes at follow up. Furthermore, fluency performance was related to annual volumetric change between baseline and follow-up, such that higher performance was related to less volumetric decline. These findings suggest that low verbal fluency may be a predictor of atrophic cortical processes in healthy elderly subjects.

E7

CORTICAL MAPPING OF AREAS SENSITIVE TO SPEECH AND ACOUSTICALLY MATCHED NON-SPEECH SOUNDS: AN INTRACRANIAL RECORDING STUDY Pierfilippo De Sanctis[1,2], Manuel Mercier[1,2], Theodore Schwartz[3], Einat Liebenthal[4], John J. Foxe[1,2], Sophie Molholm[1,2]; [1]City College of the City University of New York, [2]Albert Einstein College of Medicine of Yeshiva University, [3]Weill Cornell Medical College, New York Presbyterian Hospital, [4]Medical College of Wisconsin — Despite intensive work on the neural underpinning of speech, there is no consensus about the specific cortical regions involved in computing the sensory code of speech. We used sub-dural intracranial recordings in humans (subjects undergoing intracranial mapping of sources of seizure activity) to distinguish cortical areas sensitive to speech, acoustically matched non-speech, and simple tones. Local field potentials were recorded over temporal, parietal and frontal cortical regions with strips and grids of electrodes (resolution 3x3 mm). The Mismatch Negativity (MMN), which occurs in response to deviation from acoustical regularity in a standard oddball paradigm, served as our probe. Because the generators of the MMN are thought to reflect where the deviating feature is represented, we hypothesized that this would reveal distinct regions of cortex that were differentially sensitive to these three classes of acoustic stimuli: speech, non-speech stimuli matched for complexity, and simple tones. In all five subjects, we found regions sensitive only to complex stimuli (speech and non-speech). In three of five subjects, we also found regions sensitive only to speech stimuli. Analysis of the precise cortical locations and trends across the subjects will be reported.

E8

ASYMMETRIES IN THE MMN RESPONSE TO VOWELS BY FRENCH AND ENGLISH ADULTS: EVIDENCE FOR LANGUAGE-UNIVERSAL AND LANGUAGE-SPECIFIC BIAS Monika Molnar[1], Linda Polka[1], Shari Baum[1], Lucie Menard[2], Karsten Steinhauer[1]; [1]McGill University, [2]Université du Québec à Montréal — According to the Natural Referent Vowel (NRV) hypothesis proposed by Polka & Bohn (2003), vowels in the periphery of the acoustic/articulatory vowel space have a special perceptual status independent from native language background. This became evident in infant behavioral studies showing directional asymmetries; discriminating a change from a less peripheral vowel to a more peripheral vowel is easier compared to the same change presented in the reverse direction. Directional asymmetries have also been shown in adults when discriminating non-native vowel pairs but not when both vowels are native to the adult listener. To investigate the neural underpinnings of this perceptual bias, we recorded mismatch negativity (MMN) responses from monolingual (English, French) adults using an auditory discrimination oddball paradigm using four vowels: English [u], French [u], French [y], and an acoustically-distinct (control) [y]. Across the language groups, two patterns were observed: (1) In response to across-category vowel pairs, [u] vs [y], discrimination responses were larger and earlier when the deviant vowel was the more peripheral one, supporting the predictions of NRV, and (2) in response to within-category vowel pairs, (English [u] vs French [u]), a larger discrimination response was elicited when the deviant was a native language prototype. These findings reveal that in adulthood, a language-general perceptual bias favoring peripheral vowels is retained in the neural perceptual processing of vowels at a global level; however perception of subtle within-category acoustic differences appears to favor language-specific prototypes.

E9

READING ABNORMALITIES IN SCHIZOPHRENIA: EVIDENCE FROM THE MOVING WINDOW PARADIGM Veronica Whitford[1], Gillian O'Driscoll[2], Jan Churan[3], Ashok Malla[4], Christopher Pack[3], Debra Titone[1]; [1]Center for Research on Language, Mind, and Brain, Psychology, McGill University, [2]Psychology, McGill University, [3]Montreal Neurological Institute, McGill University, [4]Douglas Hospital, McGill University — Language disturbances are a defining feature of schizophrenia, with the majority of work emphasizing semantics. Fewer studies examine the perceptual channels through which language is encountered, such as reading. People with schizophrenia show impairments on standardized reading tests (Revheim et al., 2006), however, it is unclear how this impairment manifests in moment-by-moment reading processes. We use eye movement measures (number and duration of forward fixations, number and length of forward saccades) and perceptual span, using the classic moving window paradigm (McConkie & Rayner, 1975), to investigate this issue. People with schizophrenia and controls read 90 sentences while their eye movements were recorded. In a gaze-contingent moving window display, five conditions varied the amount of parafoveal information available at each fixation: one no-window condition, and four conditions consisting of progressively narrower windows to the right of fixation. For both groups, average first fixation duration was longer for the narrowest window relative to no window. Compared to controls, patients made more forward fixations, had shorter forward saccades, and read fewer words per minute across all windows. They also had reduced perceptual spans. These effects appear to co-vary with standardized reading tests and non-linguistic oculomotor and visual processing. Although preliminary, the results suggest that people with schizophrenia engage in a different moment-by-moment reading strategy than controls. This reading strategy may optimally compensate for a reduced perceptual span, whereby less information is extracted at each fixation. Whether such reading impairments subsequently affect higher-level language functions typically investigated in schizophrenia (semantics) is an open question.

E10

COMPARISON OF FMRI AND MEG LOCALIZATIONS DURING EXPRESSIVE LANGUAGE TASKS IN A GROUP OF ADOLESCENTS Elizabeth W. Pang[1,2], Frank Wang[1], Marion Malone[1], Elizabeth J. Donner[1,2]; [1]Hospital for Sick Children, Toronto, [2]University of Toronto — MEG tasks to localize receptive language are well established although there are no standardized tasks to localize expressive language areas. We developed two tasks for MEG and validated their localizations against fMRI data. Ten right-handed adolescents (mean=17.5yrs) were tested with fMRI and MEG on: picture verb generation (PVG) and word verb generation (WVG). MEG and fMRI results were normalized and overlaid. The number of overlapping voxels activated in fMRI and MEG were counted for each subject, for each task, at significance levels of p=0.005, p=0.001, and p=0.0005. All subjects demonstrated fMRI activations of the left inferior and middle frontal gyri at a threshold of p=0.005. With PVG, the mean number of voxels activated in this region was 266±8 on fMRI and 94±15 on MEG. The number of overlapping voxels identified by both modalities was 80±15 (79.6% overlap). With WVG, the mean numbers of voxels activated in the region of interest on fMRI and MEG were 274±11 and 113±16, respectively, with 61±13 voxels (50.2%) overlapping. With increasing significance levels, the percent overlap decreased to 46±7.3% and 26±8.0% for PVG, and 28±6.4% and 8±3.5% for WVG, at p=0.001 and p=0.0005, respectively. Our novel MEG expressive language tasks identified left frontal regions involved in language production. Percent overlap of activated voxels is high when validated against fMRI. In this cohort, PVG produced higher overlap with fMRI than WVG. The degree of overlap decreased with increasing thresholds suggesting that the neurophysiological response underlying MEG and the hemodynamic response underlying fMRI manifest differently.

E11

EYE MOVEMENT, AND ERPS AND PROSODY Shani H. Abada[1], John E. Drury[1], Karsten Steinhauer[1], Shari R. Baum[1]; [1]McGill University — The present study examined the neural correlates of semantic and prosodic processing in simple aurally presented phrases of conjoined nouns with one of two prosodic groupings (e.g., "bike # and dog and cup" versus "bike and dog # and cup). Phrases were presented concurrently with horizontal triples of pictures grouped in one of two ways (e.g., BIKE | DOG CUP vs. BIKE DOG | CUP). The visual and auditory stimuli were arranged in four conditions where the pictures either: (i) corresponded to phrases (match), (ii) differed in the phrase grouping depicted (prosodic mismatch), (iii) contained a word/picture mismatch on the second/middle noun (semantic mismatch), or (iv) differed in both phrase grouping and word/picture mismatch (double mismatch). We attempted to minimize contamination of the ERPs by horizontal eye-movements by instructing participants (N=20) to fixate in the center of the screen. Examination of HEOG signals demonstrated while some participants were able to perform the task in this way (the "non-movers", N=7), more than half (the "movers", N=13) were unable to inhibit horizontal eye-movements (first leftward, to the initial object, then steadily rightward as the auditory signal unfolded in time). In general, ERP data revealed that participants were sensitive to both prosody and semantics, as evidenced by N400 and P600 responses to both types of mismatches. However, only the ERP responses associated with prosodic mismatches, and not those driven by semantics, differed between the groups, suggesting that eye-movement behavior in this task systematically influences prosodic processing.

E12

INDIVIDUAL DIFFERENCES IN THE ANATOMY OF BROCA'S AREA Christiana M. Leonard[1], Stephen D. Towler[1], Suzanne E. Welcome[2], Christine Chiarello[3]; [1]University of Florida, [2]University of Western Ontario, [3]University of California, Riverside — How language functions are divided among anatomical compartments in Broca's Area is a subject of enduring controversy. Oddly, there appear to have been few attempts to determine how much of the variability in experimental results is due to individual variation in sulcal anatomy. In the human inferior frontal gyrus, the v-shaped pars triangularis is bordered by the anterior horizontal ramus (AHR) and the anterior ascending ramus (AAR). Pars opercularis (containing the inconstant sulcus, diagonalis (D)) is found more posteriorly. Pars triangularis is roughly associated with Brodmann's Area 45, while pars opercularis is roughly associated with BA 44. In this study we identified the locations for the consensus Talairach coordinates for phonological and semantic fluency (taken from 17 studies by Costafreda et al. 2006) in left hemisphere MRI images of 200 healthy college students. The correlates for phonological fluency were found most frequently in pars opercularis (26% in D, 54% outside of D) and AAR (24%). The correlates for semantic fluency were found most frequently in AAR (54%), other pars triangularis locations (19%), and D (16%). Only 50% of the students had a pars triangularis with the classic v-shaped formation. Individual differences in sulcal volume and location could be associated with different patterns of regional connectivity and linguistic function. It is interesting to speculate on how theoretical and computational models of language might incorporate information on individual differences in sulcal anatomy. Supported by the UF McKnight Brain Institute & NIH R01DC006957.

E13

THE SEMANTIC PRIMING EFFECT IN CONCURRENT EEG-FMRI Sebastian Geukes[1], René J. Huster[2], Andreas Wollbrink[2], Pienie Zwitserlood[1], Christian Dobel[2]; [1]University of Muenster, Germany, [2]Institute for Biomagnetism and Biosignalanalysis, Muenster, Germany — The N400 component of the electroencephalogram (EEG) is a well established indicator for the ease of retrieval of semantic information associated with a concept. Numerous studies have been conducted to reveal the neural generators of the N400 component using functional magnetic resonance imaging (fMRI). Recently, concurrent EEG-fMRI has been introduced as a means to benefit from the high temporal and spatial resolution of the respective methods while recording responses to identical stimulation. We present a semantic priming experiment using concurrent EEG-fMRI. Subjects judged whether pictured objects are manmade or naturemade. The pictures were preceded by either the object's written name, a related word, an unrelated word or a pseudoword. We hypothesized the N400 response to increase with the above mentioned order of priming conditions. After application of independent component analysis to the EEG data in order to extract fMRI-related artifacts, event related patterns of brain activity were analyzed in source space using L2 Minimum Norm Estimates. A significant N400 priming effect was found, with neural generators situated in the left temporal lobe. In fMRI data, increased hemodynamic activity was observed in the left inferior frontal gyrus and left superior temporal gyrus. The results are discussed in relation to the existing literature on the generators of the N400.

E14

NEURAL CORRELATES OF ORTHOGRAPHIC, PHONOLOGICAL AND SEMANTIC PROCESSING IN NORMAL ADULT READERS Suzanne Welcome[1], Ashlyn Swift-Gallant[1], Marc Joanisse[1]; [1]University of Western Ontario — Previous functional imaging studies in normal readers have identified a large network of brain regions that participate in the reading process. These regions may be differentially active during tasks that emphasize orthographic (word form), phonological (word sound), and semantic (word meaning) processing. We compared patterns of activation in adults during case decisions, rhyme decisions, and meaning decisions to examine brain networks engaged by each type of processing. In addition, each participant's reading ability was assessed by standardized measures before the fMRI session. Case, rhyme and meaning decisions resulted in partially overlapping regions of activation, including left temporal and inferior frontal cortex. We found that rhyme decisions resulted in greater activation of left inferior frontal cortex than case decisions, consistent with a role for this region in phonological processing. Meaning judgments, relative to rhyme decisions, resulted in greater activation in the bilateral superior frontal cortex. These findings suggest that as task demands change, broader cortical regions are recruited, with frontal regions only becoming engaged with phonological and semantic tasks. We will discuss relationships between reading skill and activity in frontal and temporal regions. Such relationships between individual differences in brain activation and individual differences in reading skill may shed additional light on the neural substrates of reading.

E15

THE LOCATIONS AND EFFECTS OF VISUAL HEMISPHERE-SPECIFIC STIMULATION ON FLUENCY IN CHILDREN WITH THE CHARACTERISTICS OF DYSLEXIA Bobbie Jean Koen[1]; [1]University of Houston — Numerous neuroimaging studies of reading processing have shown that decoding written language reliably engages three core subsystems: the temporo-parietal system associated with semantic encoding; the anterior system associated with phonological encoding; and the ventral system associated with orthographic encoding. Further, neuroimaging and intervention studies have found evidence of functionally distinct regions of interest (ROI) within each subsystem: the left hemisphere (LH) supramarginal gyrus (SMG) in the inferior parietal lobule; the posterior aspect of the inferior frontal gyrus (IFG); and the LH inferior occipito-temporal/fusiform area (OT skill zone). Identifying the manner by which these brain regions are engaged in phonological processing and developing automaticity offers valuable insight into how a distributed brain network mediates fluent reading. In this study, functional magnetic resonance imaging will be used to identify the neural organization of developing phonological analysis in students with the characteristics of dyslexia, pre- and post-intervention, as they decide if target letters within words could have the same sound, alternating with a fixation baseline and a perceptual control task requiring judgment of visual similarity of letter strings. Participants displaying activation in core reading subsystems (ROIs), namely LH SMG, bilateral IFG, and LH middle to inferior temporal gyri in the OT skill zone (MTG and ITG, respectively) will be included in functional connectivity analysis. The results are expected to show strong bi-directional, intrinsic connections between the three ROIs, with the strongest connections between the IFG and MTG/ITG. This will form a basis for establishing the neural networks that contribute to automaticity of processing.

E16

FMRI EVIDENCE FOR AUTOMATIC SPEECH CATEGORIZATION IN EARLY AND LATE BILINGUALS Pilar Archila[1], Elizabeth Owens[1], Jazon Zevin[2], Arturo Hernandez[1]; [1]University of Houston, [2]Weill Medical College of Cornell University — How accurately novel sounds are assigned to L2 categories depends on the age at which the second language was acquired and the level of L2 proficiency. With the use of clustered acquisition in fMRI, the current study investigated the preattentive categorization of nonnative speech syllables (i.e., saf, sof, and suf) in a population of early and late Spanish-English bilinguals with varying degrees of proficiency. In the scanner and using a passive listening paradigm, participants were asked to watch a video while syllables played through the headphones. The blocks of nonnative syllables were presented during silence intervals between scans. Each block consisted of 5 trials and each trial consisted of a pair of stimuli. Each trial was one of the 6 combinations generated – classified as "same"(saf-saf, sof-sof, suf-suf) or, "different" (saf-sof, saf-suf, sof-suf). Preliminary results showed that for the contrast of 'same vs. different' trials, early bilinguals activated areas in the right middle and left inferior frontal gyrus -par opercularis, whereas late bilinguals activated areas in the left inferior frontal gyrus-par triangularis and the left supplementary motor area. Previous studies investigating other types of categorization have also reported activity in frontal regions. Activity in the SMA, however, suggests that late bilinguals persistently attempt to decode nonnative syllables by covertly saying them to themselves, despite the automatic nature of the task. This, in turn, suggests that activity in the SMA in late bilinguals corresponds to the, perhaps effortful, categorization of novel L2 speech sounds.

E17

AUDITORY SCENE PERCEPTION IN CHILDREN WITH DEVELOPMENTAL LANGUAGE DISORDERS Elyse Sussman[1]; [1]Albert Einstein College of Medicine, Bronx, NY — Phonological processing impairments are often observed in individuals with developmental language disorders but there is considerable debate about what causes these impairments. A main disagreement is centered on whether they can be attributed to specific linguistic deficits or to more general acoustic processing deficits, such as difficulty in processing rapidly changing acoustic information. The auditory environment is a dynamically changing and noisy place with overlapping acoustic information originating from simultaneously active sources. A key function of the auditory system is the ability to integrate sensory inputs that belong together and segregate those that come from different sources. We hypothesized that this complex acoustic processing skill may be impaired in children with language difficulties. To test this, we assessed the ability of school-aged children to parse auditory input and perceive sound streams, and determined whether the presence of phonological processing impairments was predictive of stream segregation performance. We found that children with language disorders did not segregate streams as well as their age-matched peers, requiring larger frequency separations to hear distinct streams. Moreover, phonological processing ability was a strong predictor of whether or not children reported hearing discrete sound streams. These data are consistent with the hypothesis that certain general auditory processing strategies are impaired in children with language difficulties. The results suggest that children with developmental language disorders may have difficulty parsing speech streams, or identifying individual sound events, when there are multiple competing sound sources.

E18

THE ROLE OF AREA PE IN WRITING Emily Ferreira[1], Michael Petrides[1]; [1]Montreal Neurological Institute, McGill University — The present imaging study aimed to elucidate the brain areas centrally involved in writing. The experimental and control tasks were well-matched for variables not directly related to writing, such as visual stimulus characteristics, generating and retrieving the object's name, and basic hand movement. Comparison of the BOLD signal in the writing conditions with that in the control conditions revealed increased activity in the premotor cortex, the primary motor and sensory hand region and, further caudally, in the rostral part of the superior parietal lobule (area PE) in the left hemisphere. In addition, there was increased activity in the cingulate motor areas, the secondary somatosensory cortex (SII) in the upper bank of the Sylvian fissure and the insula, again in the left hemisphere. Area PE, which is directly linked with posterior cortical areas and premotor/motor cortex, can be a critical interface between posterior cortical regions in the left hemisphere involved in language processing with the central motor and sensory region that is directly involved in the control of movement. An interaction analysis of functional connectivity demonstrated that area PE functions more closely with the left angular gyrus when the writing is in response to words that are read. In sharp contrast, when the writing is in response to pictured objects, then the interaction is with the supramarginal gyrus, an area that is involved in the articulatory and phonological loop, as well as with prefrontal regions that are involved in the retrieval and selection of semantic information.

E19

CLOSURE POSITIVE SHIFTS (CPS) : EVOKED BY PROSODIC RHYTHM-GROUPS IN MEANINGFUL AND MEANINGLESS SPEECH Annie C. Gilbert[1], Boutheina Jemel[1], Victor J. Boucher[1]; [1]Université de Montréal — The speech stream can bear two types of prosodic marks: language specific and structural. The latter marks, which are associated with rhythm and intonation groups (RGs and IGs), are universal and occur spontaneously during oral recall. Using Event Related Potentials (ERPs), IGs have been found to evoke a "closure positive shift" (CPS) (Steinhauer et al. 1999, Pannekamp et al. 2005). The present study adopts the view that CPS reflects instead the effects of RGs and captures the online segmentation of speech. We conducted two experiments using 100 meaningful utterances (Experiment 1) and 100 meaningless series of syllables (Experiment 2) where 2 RGs of varying length (3-4 syllables) were inserted within an IG. ERPs were averaged with respect to RGs. The averaged potentials show that the CPS is specifically evoked by RGs in both experiments, confirming that these potentials link to prosody and not to semantic or syntactic units. The results also bear implications with regard to an on-line segmentation of speech based on RGs, a principle that conforms to grouping effects on the recall of verbal series (Boucher 2006) and the hypothesis of a limited focus of attention (Cowan 2000).

E20

AN ERP EXAMINATION OF PRONOUN RESOLUTION IN SCHIZOPHRENIA Tali Ditman[1,2], Kana Okano[2], Gena Gorlin[2], Donald Goff[1], Gina Kuperberg[1,2]; [1]Massachusetts General Hospital, [2]Tufts University — An impaired use of cohesion markers, such as pronouns, in patients with schizophrenia is well documented during production and has been postulated to be a trait-marker of the disorder. However, no study has examined the underlying neurocognitive mechanisms mediating this impairment. The present study employed event-related potentials (ERPs) to examine pronoun resolution during reading comprehension in schizophrenia. Patients and healthy matched controls read sentences that contained an ambiguous pronoun ("he" in "Mark and John went to the store because he needed milk"), a failing pronoun ("she" in "Mark and John went to the store because she needed milk"; "she" in "Mark went to the store because she needed milk"), or an unambiguous pronoun ("he" in "Mark went to the store because he needed milk"). Examination of neural activity evoked to ambiguous pronouns relative to unambiguous pronouns in healthy controls showed a larger Nref component, suggesting increased working memory demands associated with keeping two potential antecedents online in order to resolve the ambiguity. In patients, however, an Nref was not evoked, implicating a working memory deficit in pronoun comprehension. Moreover, whereas controls exhibited a larger amplitude P600 to failing relative to unambiguous pronouns, patients with schizophrenia exhibited both a larger amplitude N400 and P600 effect to these failing pronouns, suggesting that they may engage different cognitive processes in attempting to resolve these pronouns. These findings are the first to demonstrate a neurocognitive impairment in establishing referential coherence across clauses in schizophrenia.

E21

DO LANGUAGE AND ACTION PRODUCTION SHARE A COMMON NEURAL SUBSTRATE? And Turken[1], Nina Dronkers[1,2]; [1]Research Service, Veterans Affairs Northern California Health Care System, [2]University of California, Davis — We investigated the relation between language impairments in aphasic patients and deficits in producing purposeful movements (praxis). Using neuropsychological (Western Aphasia Battery, WAB) and brain imaging (MRI and CT) data from 136 chronic left hemisphere stroke patients with aphasia, the behavioral and neural correlates of motor planning and action production (praxis) and language impairments were compared. Praxis deficits were correlated with comprehension impairments ($r = 0.74$), aphasia severity ($r = 0.69$), repetition problems ($r = 0.67$) and less strongly with impaired fluency (0.53). Analysis of WAB praxis subtest performance (maximum score = 60) by aphasia type showed that the patients with global or Wernicke's aphasia had the lowest performance (mean = 21.2 and 33.4, respectively). Broca's and conduction aphasics were in the middle range (43.1 and 50), whereas anomic aphasics and the patients within normal limits on the WAB had spared praxis performance (57.4 and 58.8). Voxel-based lesion-symptom mapping (VLSM) analysis revealed that the lesions associated with impaired motor planning, comprehension and repetition show strong overlap in the left parietal lobe (supramarginal and angular gyri), the left temporal lobe (posterior superior temporal and posterior middle temporal gyri), as well as the left superior and inferior longitudinal fasciculi (SLF, ILF) and the arcuate fasciculus (AF). Praxis and fluency VLSM maps overlapped mainly in the superior temporal lobe and the superior longitudinal fasciculus. These findings are consistent with the notion that motor planning and language share common neural mechanisms.

E22

NEURAL CORRELATES OF THE PERCEPTION OF PROSODIC FOCUS IN FRENCH: AN FMRI STUDY Marcela Perrone[1], Marion Dohen[2], Hélène Loevenbruck[2], Marc Sato[2], Cédric Pichat[1], Gaëtan Yvert[1], Monica Baciu[1]; [1]Laboratoire de Psychologie et NeuroCognition, [2]GIPSA-lab — The studies of the neural correlates of the perception of prosody have led to different conclusions (for a review: Baum & Pell, 1999). The present functional magnetic brain imaging (fMRI) study deals with the perception of prosodic contrastive focus in French (example: Mary ate the apple? No, JOHN ate the apple; see Wildgruber et al., 2004; Tong et al., 2005 for related studies). Twenty-two right-handed French speakers participated in the experiment. The two conditions consisted in the auditory judgement of two kinds of utterances: with contrastive prosodic focus (Focus condition, Task) and without (Neutral condition, Control). The stimuli were delivered via headphones. The task was to judge whether the utterances contained focus or not. The subjects answered using two response keys. An event-related paradigm was designed (48 events per condition; 30 null-events). The behavioural responses were correct in more than 90% of the trials. The Focus vs. Neutral contrast revealed bilateral frontal activation (left BA 6 and BA 47 and right BA 44 and BA47), temporal activation (left BA 22 and right BA 21) and parietal activation (bilateral BA 40 and left BA 7). The Neutral vs. Focus contrast showed activation in the post-central gyrus (BA 1, 43) and left insula. A ROI analysis showed significant left hemisphere predominance for left inferior frontal (BA 47) and supramarginal (BA 40) gyri, as well as for left anterior insula (BA 13) during the Focus condition. Overall, these results suggest that the auditory perception of contrastive prosodic focus involves a left-dominant temporo-parieto-frontal network.

E23

AN FMRI STUDY OF CUED SPEECH IN DEAF NATIVE USERS Mario Aparicio[1], Philippe Peigneux[1], Brigitte Charlier[1], Jacqueline Leybaert[1]; [1]Universté Libre de Bruxelles (Belgium) — Functional neuroanatomy of speech perception in oral languages has been described taking account data from audio-visual speech. However, Cued Speech (CS), a system of manual aids developed to help deaf children to understand speech by eliminating lipreading ambiguity, has shown that we can perceive complete linguistic information of the oral language without need of auditory input. Therefore, accurate speech perception of oral language may be perceived through different modalities (audio-visual vs. visual only). But, will they be differently processed? In other words, to what extent are functional brain systems shaped by different linguistic input modality? In the first neuroimaging study of the perception of French CS (FCS), we explored this question by measuring brain activation using fMRI in a group of deaf native users of FCS while they performed a FCS word-perception task. A group of hearing performed an analogous task that involved audio-visual French words. Results show an important common activation generated by both audio visual French in hearing users and FCS in deaf users in the temporal lobe and inferior prefrontal regions. This data support the argument that much of the linguistic treatment is modality independent. However, they were also some differences: audio visual speech had a greater activation in primary and secondary auditory cortices while FCS generated enhanced a strong activation in MT/V5 occipito-temporal region suggesting they were also some modality-dependent language localization patterns in both groups.

E24

SWITCHING LANGUAGES MAKES L1 SUFFER: AN ERP STUDY ON LANGUAGE MIXING USING OVERT SPEECH Ingrid K. Christoffels[1,2], Carien Caljouw[2], Lorenza Colzato[1,2], Lourens J. Waldorp[3]; [1]Leiden Institute for Brain and Cognition (LIBC), [2]Leiden University, [3]University of Amsterdam — In research on bilingual speech production it is hotly debated how? control of language comes about. Recent studies showed that especially? the first language (L1) suffers when switching between languages. This? might be explained by sustained inhibition of the L1 to equate ?accessibility with the second language in mixed language contexts ?(e.g., Christoffels et al, 2007). Presently, we try to assess? the extent of the L1 adaptation to language mixing. We administered a? switching task with only 10% switches were the same language was repeated language for? at least 7 trials while obtaining behavioral and ?electrophysiological measures. This allowed for a detailed analysis of? how local language requirements influence naming in L1 and L2. As predicted, we found slower L1 than L2 reaction times on the first same language? repeat, replicating previous results. Against expectations, even after 7 repeats, reaction times did not? become any faster for either L1 or L2. However, ?analysis of variances showed decreased variability in response time with? increasing repeats for L1. ERP analysis? indicated modulation of the waveform in the N400 time window, for the L1 only. Finally, the extent of L1 adaptation across tasks was clearly ?shown when comparing blocked naming in L1 and L2 only before and after switching, naming in L1 was faster than L2 before switching but this was reversed after switching, where ERP amplitudes were more negative. Within and across tasks effects ?of language mixing indicate strong global and subtle local? changes in L1 processing due to mixed language circumstances.

E25

ERP EVIDENCE FOR PHONOLOGICAL AND LEXICAL PROCESSING OF NON-NATIVE PHONEMIC CONTRASTS IN LATE SECOND LANGUAGE LEARNERS Erin White[1], Masha Westerlund[1], Fred Genesee[1], Debra Titone[1], Karsten Steinhauer[1]; [1]McGill University — The present study addressed two questions: How do late second language learners process speech sounds, and words containing those sounds, that are part of their second language (L2) but not their first (L1)? How does L2 proficiency modulate processing? Native English speakers and late French-English bilinguals participated in two experiments that investigated a speech contrast that is phonemic in English but not in French, and is notoriously difficult for Francophones to produce: /h-Ø/. Experiment 1 measured MMN and P300 responses to the contrast in an attended odd-ball paradigm. Experiment 2 measured N400 responses to word and to pseudo-word primes created by adding or deleting an /h/ (i.e. "appy") and semantically associated targets ("sad"). Native English speakers were sensitive to the /h-Ø/ contrast at both phonological and lexical levels; they displayed MMN/P300 responses in the odd-ball paradigm, a larger N400 to pseudo-words than words (i.e. "appy" vs "happy") and an N400 priming effect only to word-word pairs ("sad" when it followed "happy" but not "appy"). Francophones, as a group, displayed smaller MMN/P300 responses and did not appear to differentiate between word and pseudo-word primes (i.e. both "appy" and "happy" primed "sad" to the same extent). However, the amplitude and presence of these components varied as a function of L2 proficiency. Taken together, these results suggest that late Francophone learners of English have persistent difficulties perceiving this non-native phonemic contrast, although some can learn to process it with increased proficiency.

E26

THE CLINICAL AND NEUROPHYSIOLOGICAL IMPACT OF INTENSIVE APHASIA TREATMENT K. Ryan Wilson[1], Heather O'Rourke[1], Linda Wozniak[1], Ellina Kostopoulos[1], Yannick Marchand[2], Ryan D'Arcy[2], Aaron J. Newman[1]; [1]Dalhousie University, [2]National Research Council of Canada — Evidence suggests that intensive speech-language therapy for aphasia can lead to significant improvements in language ability, even in chronic aphasia. One such program is the Intensive Residential Aphasia Communication Therapy program (InteRACT), an intensive 4-week long program with over 100 hours of speech-language language therapy. Our goal was to characterize the effects of intensive therapy on the N400, an ERP effect associated with lexical processing. We hypothesized that in aphasics who benefitted from treatment, the N400 would become larger and have shorter latencies more closely resembling the N400 of control subjects. Eight aphasic patients and 8 matched controls performed a task in which they had to determine whether a spoken word was a 'match' or a 'mismatch' for a presented image. Each aphasic completed the task immediately before and and after the InteRACT program; controls performed the task twice with a 4 week interval between sessions. Seven of the eight aphasics showed clinically significant gains on standardized language testing from the beginning to the end of InteRACT. Post-therapy, the aphasic group showed a significantly earlier onset latency of the N400, as well as a more left-lateralized scalp distribution. These results suggest that the N400 can be a sensitive measure of neural reorganization associated with treatment for aphasia.

E27

INTER-CODE CONNECTIONS BETWEEN ARITHMETIC REPRESENTATIONS IN THE BILINGUAL BRAIN Elena Salillas[1], Nicole Y. Y. Wicha[1,2]; [1]University of Texas at San Antonio, [2]University of Texas Health Science Center at San Antonio — Salillas and Wicha (2009 JOCN, suppl. 1) showed that the language of learning arithmetic (LolA) and Digit formats have stronger and better arithmetic representations compared to a bilingual's other language (Ll2). Here we use ERPs to explore the connections between these formats with two goals: 1) determine if either of the preferred codes is accessed to facilitate processing in Ll2 and 2) determine the degree of automaticity in the connections between each format. Participants made correctness judgments to simple multiplication problems (2x3) with correct (6), incorrect table-related (9) or unrelated (7) solutions, which were always presented in a different code than the operands (e.g., LolA-Ll2, two three seis). ERPs measured from solution onset showed an N400 correctness effect, an index of automaticity in the spread of activation between concepts, for all code switched solutions, with a significantly smaller effect for the Digit to Ll2 switches compared to the others. The N400 relatedness effect, which reflects finer-grained connections between arithmetic concepts in a network, was observed only between the stronger codes (Digit-LolA and LolA-Digit), and when going from the stronger LolA to the weaker Ll2. In contrast, only a later positive component, thought to index more controlled processing, was modulated by relatedness in switches from Ll2, and when going from Digits to Ll2. In sum, connections from Ll2 to the other codes are less refined and less automatic, while the bidirectional connection between LolA and Digit codes is strong. Modifications to the existing bilingual arithmetic model are suggested.

E28

PROSODIC PHRASING IN SPOKEN KOREAN GARDEN PATH SENTENCES: AN ERP STUDY Hyekyung Hwang[1], Karsten Steinhauer[1]; [1]Centre for Research on Language, Mind, and Brain, McGill University — It is well-known that prosodic structure plays an important role in the recovery of syntactic structure (e.g., Clifton et al., 2002, Kjelgaard & Speer, 1999). Prosodic boundaries at potential syntactic boundaries facilitate (dispreferred) processing, whereas prosodic boundaries that mismatch syntactic boundaries lead to initial misunderstandings ('garden-path' effect). The immediate use of prosodic information in the comprehension of temporarily ambiguous sentences has been demonstrated by ERP investigations (e.g., Steinhauer et al., 1999), but cross-linguistic evidence is still limited. We present data from our first ERP study investigating spoken Korean garden path sentences to test the same paradigm used in the previous Korean ERP study in reading (Hwang & Steinhauer, 2009) and thereby to further specify the cognitive mechanisms of prosodic online processing as well as respective ERP correlates. An early ambiguous dative noun-phrase (NP) following a matrix subject phrase can locally associate with the matrix or the relative clause. By changing the position of a second dative NP (either in the matrix or the relative clause), two different unambiguous interpretations were construed. Prosodic patterns were defined by comparing the boundary sizes surrounding the ambiguous NP: prosodic structures cooperated or conflicted with syntactic structures to different extent. Prosodic patterns were crossed with matrix subject length. Filler sentences included various types of ungrammatical sentences. As predicted and similar to the previous reading study, ERP data of 36 Korean speakers showed the Closure Positive Shift at prosodic boundaries. Also, different patterns of prosodic phrasing caused or prevented garden-path effects at the end of sentences.

E29

BRAIN RHYTHMS AND SPEECH RATE: THETA BAND RESPONSE TO COMPRESSED SPEECH Veronica Figueroa[1,2], Greg Cogan[1,3], Oded Ghitza[4], David Poeppel[3]; [1]University of Maryland, [2]Pontificia Universidad Católica de Chile, [3]New York University, [4]Boston University — The objective of this study was to explore the brain response to rate variations in speech. The experiments used compressed speech as a way to understand how representations of brain rhythm might underlie speech perception. We tested the hypothesis that a brain parameter responsive to rate is phase coherence in the theta band. This particular response of the theta band has been proposed by Luo and Poeppel (2007) as a brain 'metric' that is relevant for speech processing, specifically allowing the discrete sampling of speech, at a pace that coincides with the timing of relevant linguistic events such as syllables. Predictions were that the frequency of the phase coherence response would be modulated according to stimulus rate variation. Specifically the peak of phase coherence response would shift to higher frequencies as stimulus rate gets faster. The predicted shift in frequency was not observed. Nevertheless, results show that the magnitude of phase coherence response is modulated with rate. Phase coherence response increased with compression to reach a maximum for 33% compressed speech (3 times faster than normal speech). Results suggest that there is an endogenous rhythm with stable intrinsic properties specially tuned for the processing of normal speech. The inherent properties of the system modulate and constraint brain response to changing speech stimuli. The results of this study do not yet have a straightforward interpretation, but open several interesting questions about the role of brain rhythms underlying speech processing.

E30

LONGITUDINAL CHANGE IN MMN RESPONSES TO ENGLISH VOWELS BY A SPANISH-SPEAKING LEARNER OF ENGLISH Paula Garcia[1], Karen Froud[1]; [1]Teachers College, Columbia University — Mismatch Negativity responses (MMN) are known to reflect phonological memory traces specific to native language contrasts (Peltola et al., 2003). Second language learners are able to acquire native-like representations of non-native speech sound contrasts; however it is not known when in L2 acquisition this change in representational capability occurs. We examined MMN responses to a non-native vowel contrast (/i/ vs. /I/) in an adult male native Spanish speaker from his first English lesson (time 1), and twice more at monthly intervals (time 2 and time 3). This vowel contrast is of particular interest in Spanish-speaking learners because it is often reported that the English /I/ gets perceptually assimilated to Spanish /i/.(Escudero & Boersma, 2004). In an auditory oddball paradigm, the participant was asked to ignore binaurally presented English vowel sounds /i/ and /I/, presented in a CVC context by two female speakers, and watch a silent movie while EEG was recorded. It was observed that MMN responses to the vowel contrast changed with English exposure over the 3 testing sessions: there was no discernible MMN at time 1 or time 2, but a clear MMN by time 3. The pattern of responses observed suggests a re-organizational process affecting phonological memory traces associated with the novel English vowel /I/. Results are consistent with previous research showing that adults can learn to perceive phonemes that do not exist in their native language, even though some phonemes would be more difficult than others (Best & Strange, 1992).

E31

EVENT-RELATED POTENTIALS REVEAL THAT L1 PHONOLOGY AFFECTS L2 RHYTHM PERCEPTION Maren Schmidt-Kassow[1,2], Paula Roncaglia[2], Kathrin Rothermich[2], Sonja A. Kotz[2]; [1]Institute of Medical Psychology, University of Frankfurt, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Event-related potential (ERP) data from German natives have shown that metric foot violations in a sentence elicit a biphasic ERP pattern consisting of an anterior negativity and a posterior positivity (P600; Schmidt-Kassow & Kotz, 2009a). However, proficient French late learners of German are not capable to identify these metric incongruencies in German sentences and fail to show a comparable ERP response (Schmidt-Kassow & Kotz, 2009b). We argued that this result is due to the lack of lexical and contrastive stress in the French in contrast to the German stress system. Thus, French speakers are 'stress deaf' given the fact that they are not able to discriminate two stimuli that vary in their stress position (Dupoux et al., 2008). This in turn seems to result in 'metric deafness', i.e. the insensitivity for the concept of a metric foot. Here, we conduct the same experiment with Spanish late learners of German. Contrary to French, lexical and contrastive stress is implemented in Spanish. Thus, if the metric deafness observed in French late learners is due to differences in the native stress system we expect Spanish late learners of German to show a similar biphasic ERP pattern in response to metric incongruencies as reported for German natives. In contrast to French natives Spanish natives accurately judge the metric homogeneity of the presented sentences and show a biphasic ERP in response to metric incongruencies. We thus argue that the sensitivity for metric feet is highly dependent on phonological representations of stress during first language acquisition.

E32

ACTIVATION CHANGES AFTER BEHAVIORAL INTERVENTIONS FOR APHASIA: DOES TREATMENT TYPE MATTER? Elizabeth H. Lacey[1,2], Susan N. Lott[1], Rhonda B. Friedman[1]; [1]Georgetown University Medical Center, [2]Interdisciplinary Program in Neuroscience — We used fMRI to examine shifts in activation in persons with aphasia (PWA) associated with continued practice of treated items after they have reached a pre-set performance criterion. We have shown previously that items learned to criterion (LTC) are associated with activation in right hemisphere (RH) perisylvian areas, whereas items learned beyond criterion (LBC) are associated with activation in left hemisphere (LH) areas surrounding the patient's lesion. This pattern mimics the shifts in activation that have been shown to occur during spontaneous recovery of language. Our previous study focused on a treatment that used a mediating strategy to circumvent a damaged system. The current study examines LBC in a treatment that does not employ a mediating strategy in order to determine if the same shifts in activation occur. We used a non-mediating treatment for picture naming with patient JMC, who suffered an arteriovenous malformation rupture 2 years prior to the study. Similar to our findings for a mediating treatment, post-treatment naming was associated with recruitment of RH homologs in areas known to be active during naming in controls. Moreover, trained words were associated with greater bilateral frontal activation than words JMC could name pre-treatment, possibly reflecting increased effort. Data collection for LBC items is ongoing with JMC and others to determine if it will be associated with a LH shift. In conclusion, activations associated with successfully treated items may reflect the level of automaticity with which words are produced, rather than the type of treatment used to retrain them.

E33

STATEMENT: QUESTION CATEGORIZATION IN CONGENITAL AMUSIA Nathalie Gosselin[1,2], Sean Hutchins[1], Isabelle Peretz[1]; [1]BRAMS, University of Montreal, [2]Faculty of Music, University of Montreal — Congenital amusia (or tone deafness, as it is commonly called) involves problems in pitch discrimination. Although this is most salient in music-related tasks, pitch also plays a central role in linguistic prosody. In particular, the distinction between sentences spoken as a question or as a statement relies heavily on the pitch contour of its final syllables. Prior studies have differed on whether amusia can cause difficulties in discriminating between statements and questions (Ayotte, Peretz, & Hyde; 2002; Patel et al., 2008). In this experiment, we examine how amusics categorize small differences along the statement / question continuum. The stimuli were sentences which had different prosodic interpretations created by manipulating the pitch height of the final syllables. Eleven different final syllable pitch heights were used, creating a prosodic continuum with equal steps varying between clear statement and clear question. Amusic and control participants were asked to listen to each and judge whether it was an example of a statement or a question. Logistic regression analyses were used to compare amusic and control groups. Results showed that, while amusics and controls divided between statements and questions at the same boundary point, amusics showed less consistency in their judgments, with more errors overall. These results help to clarify earlier studies, and suggest that amusics and controls categorize statements and questions according to the same rules, but amusics do so less accurately in general.

E34

SHARED AND DISTINCT NEURAL CORRELATES OF VOWEL PERCEPTION AND PRODUCTION Marc Sato[1], Krystyna Grabski[1], Laurent Lamalle[2,3], Jean-Luc Schwartz[1], Coriandre Vilain[1], Nathalie Vallée[1], Irène Troprès[2,4], Monica Baciu[5], Jean-François Le Bas[2,6]; [1]GIPSA-Lab, CNRS, Grenoble Universités, France, [2]Institut Fédératif de Recherche n° 1 "RMN Biomédicale et Neurosciences", CHU de Grenoble, France, [3]INSERM, France, [4]Université Joseph Fourier, Grenoble, France, [5]Laboratoire de Psychologie et NeuroCognition, CNRS & Université Pierre Mendès France, Grenoble, France, [6]Centre Hospitalier Universitaire de Grenoble, France — Although a functional distinction between frontal motor sites for speech production and temporal auditory sites for speech perception has long been postulated, some recent neurobiological studies rather argue for a tight connection between speech perception and production systems. In the present functional magnetic resonance imaging study, we investigated whether common brain areas might participate in both vowel perception and production. In order to minimize scanner noise and movement-related imaging artifacts, a sparse sampling acquisition technique was used where participants produced or passively listened to a vowel (previously recorded from their own voices) during a silent interval between successive image acquisitions. Direct comparisons between speaking and listening conditions revealed specific activations for speaking in the sensorimotor cortex, the supplementary motor area, the basal ganglia and the posterior cingulate gyrus. In addition, specific reduced responses were also observed in the supramarginal gyrus, which are likely to reflect motor-to-sensory feedback control mechanisms. Finally, a conjunction analysis showed a shared neural network for vowel perception and production, with common activations in the left inferior frontal gyrus and in the superior temporal gyrus/sulcus bilaterally. Interestingly, although previous studies have demonstrated activation of the ventral premotor cortex in passive speech perception, the overlapping frontal activations were here largely confined to the inferior frontal gyrus. The absence of response in the ventral premotor cortex during vowel perception might be due to the perception of participant's own voice that does not explicitly require a mapping of perceived vowel onto internal motor representations of articulatory gestures.

E35

ATTENDING TO EVENTS: WHAT, HOW, AND WHERE? Alexander Kranjec[1], Eileen Cardillo[1], Anjan Chatterjee[1]; [1]Center for Cognitive Neuroscience, University of Pennsylvania — Dynamic spatial events can be described not just in terms of agents and goals, but also with regard to the path and manner of motion involved. Path refers to the trajectory of an object relative to some external reference, or where it moves; manner refers to the intrinsic motion of an object, or how it moves. Across languages, distinct linguistic elements are typically used to express these different motion properties (e.g. prepositions vs. verbs in English). To consider the hypothesis that this linguistic parsing of events mirrors a neural segregation in the processing of these motion components, we tested 20 right-hemisphere injured patients on a blocked event perception task. Patients attended either to the Creature, the Manner, or the Path of 3-second animations and indicated whether the attended dimension changed relative to the previous trial. Performance on Creature trials exceeded 90% accuracy, but a motion processing deficit was evidenced by significantly lower accuracy in both Manner and Path conditions (73% and 67%, respectively). Despite comparable behavioral impairment in the recognition of these two event attributes, voxel-based lesion symptom mapping (VLSM; Bates et al, 2003) indicated a relative dorsal/ventral distinction in the neural substrates for path and manner perception. Consistent with previous neuroimaging research (Wu et al, 2003), these results support a further partitioning of the "where" motion-processing stream into dorsal and ventral segments attuned to different types of motion. These findings also accord with a variety of research demonstrating close parallels between the functional organization of perception and language.

E36

ERP EVIDENCE ON JAPANESE INTERJECTIONS: PITCH DRIVES THE VALENCE EFFECT Masako Hirotani[1,2], Sonja Kotz[3]; [1]Carleton University, Ottawa, Canada, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [3]Max Planck Institute for Human Cognitive and Brain Sciences, Neurocognition of Rhythm in Communication Group, Leipzig, Germany — The present study investigated ERP correlates for emotional prosody, using Japanese interjections. Japanese is unique in that (i) a wide variety of interjections such as 'ah' and 'oh' appears in daily conversation and that (ii) their pitch modulation (e.g., high to low, low to high) systematically shifts emotional valence (positive, negative). The experiment tested six different kinds of monosyllabic interjections in three emotion conditions, positive, negative, and neutral, each corresponding to high to low, low to high, and flat in pitch. The stimuli were played to 24 Japanese listeners and their ERP responses were collected. The results are summarized as follows: (i) In the N1 time window (50-150 ms) both neutral (flat in pitch) and negative (low to high) conditions elicited an anterior-central negativity, compared with the positive condition (high to low); (ii) in the P2 window (150-300 ms) the negative interjections showed an anterior-central negativity, compared with the positive and neutral conditions; and (iii) in the N400 window, the neutral condition was more negative than the positive and negative conditions. Based on the distribution of obtained ERP patterns and acoustic properties of stimuli, these results likely suggest three distinct processing stages for Japanese interjections: the first stage (N1) attributed to processing acoustic properties of interjections, deviant (low to high and flat) vs. non-deviant (high to low), the second stage (P2) involving salient (negative) vs. non-salient emotional processing (positive and neutral), and the third stage (N400) for integrating processed emotions into meaningful (fall and rise) vs. meaningless (neutral) context.

Emotion & Social: Emotional Responding

E37

CEREBRAL ACTIVATIONS ASSOCIATED WITH PROCESSING OF AVERSIVE STIMULI IN WOMEN WITH SCHIZOPHRENIA AT TWO DIFFERENT PHASES OF THE MENSTRUAL CYCLE Annie Dubé[3], Nadia Lakis[1,2], José Jiménez[1,2], Adham Mancini-Mariё[1,2], Marc Lavoie[1,2], Emmanuel Stip[1,2], Adrianna Mendrek[1,2]; [1]Centre de Recherche Fernand Seguin, Louis-H Lafontaine Hospital, Canada, [2]University of Montreal, [3]Concordia University, Montreal, Canada — A relationship between emotion processing and different phases of the menstrual cycle has been documented in healthy women (HW). Also, impaired emotion processing is a fundamental component of schizophrenia. Thus, the aim of the present study was to investigate the link between emotion processing and distinct phases of the menstrual cycle in schizophrenia women (SZ-W). Thirty-five women (17-HW, 18-SZ-W) underwent functional MRI while viewing negative images selected from the International Affective Picture System (IAPS). The task was performed twice at two different phases of the menstrual cycle. There were no differences between the groups in subjective rating of emotional images. HW had significantly stronger and more widespread activations during the luteal relative to the follicular phase in the right(R)-postcentral, bilateral(B)-temporal inferior and left-supramarginal gyrus. SZ-W also demonstrated increased activations, but only in the circumscribed region of the R-superior occipital cortex. While no significant differences were found between patients and controls in the follicular phase, SZ-W showed less cerebral activations compared to HC during the luteal phase in the B-postcentral, R-cerebellum, R-superior frontal, B-superior temporal, R-superior parietal, B-putamen and B-middle frontal regions. To summarize, the pattern of cerebral activations induced by viewing negatively valenced images was stable over time in SZ-W but fluctuated significantly in HW leading to conclusion that the relative impairment in emotion processing in SZ-W is menstrual cycle phase-dependent. Further investigations will examine the potential implications of estrogen in emotion processing across the two phases.

E38

ACCENTUATE THE POSITIVE: LONGITUDINAL EFFECTS OF INTENSIVE MEDITATION TRAINING ON MODULATION OF THE EMOTION POTENTIATED STARTLE REFLEX Brandon G. King[1], Anthony P. Zanesco[1], David A. Bridwell[2], Tonya L. Jacobs[1], Stephen R. Aichele[1], Katherine A. MacLean[3], Phillip R. Shaver[1], Erika L. Rosenberg[1], Baljinder K. Sahdra[1], Emilio Ferrer[1], B. Alan Wallace[4], Clifford D. Saron[1]; [1]University of California, Davis, [2]University of California, Irvine, [3]Johns Hopkins University, [4]Santa Barbara Institute for Consciousness Studies — We investigated modulation of the emotion-potentiated eyeblink startle in a longitudinal, wait-list controlled study of intensive meditation training. Participants were assigned to matched training (N=17) or control (N=18) groups. The training group completed three months of instruction and practice in meditation techniques aimed at promoting focused attention and emotional balance. Both groups were tested onsite at a remote meditation center using counterbalanced stimuli sets at pre- and post-training. Participants viewed positive and negative pictures (6000ms duration, 15-18s ISI) from the International Affective Picture System accompanied by acoustic startle probes. Bursts of white noise (50ms, 100dB peak SPL) occurred at 1500ms, 4500ms, or 7000ms following picture onset. Analyses indicated that startle magnitude (50ms baseline to 20-120ms post-probe peak rectified EMG amplitude) was dependent on picture valence and probe timing, with maximum magnitudes occurring at 4500ms. Negative picture stimuli elicited greater overall magnitudes than positive stimuli. We quantified emotion potentiation (EP) as the magnitude difference between the startle responses that were most influenced by emotional arousal (4500ms) and a baseline response (1500ms). A repeated measures ANOVA revealed a significant interaction of group, testing, and valence. Follow-up comparisons showed a significantly greater EP for positive pictures in the training group at post-test, indicating greater arousal to positive stimuli. No group differences in EP for negative pictures were found. Meditation practice promoted continued engagement with familiar positive stimuli at post-test, leading to increased positive arousal despite the presence of highly arousing negative stimuli. In contrast, controls appeared to habituate to the positive stimuli.

E39

TEMPORAL DYNAMICS OF ANTERIOR CINGULATE CORTEX INVOLVEMENT IN PROCESSING OF INFANT STIMULI Birgit Wieckhorst[1,2], Isabella Mutschler[1,2], Markus Klarhöfer[3], Frank H. Wilhelm[4], Franz Müller-Spahn[2], Erich Seifritz[5], Tonio Ball[6,7]; [1]Psychology, University Basel, Switzerland, [2]Psychiatry, University of Basel, Switzerland, [3]MR-Physics, University Hospital Basel, Switzerland, [4]Faculty for Psychology, Clinical Psychology and Psychotherapy, University of Basel, Switzerland, [5]Clinic for Affective Disorders and General Psychiatry, Psychiatric Hospital Zurich, Switzerland, [6]Bernstein Center for Computational Neuroscience, University of Freiburg, Germany, [7]Epilepsy-Center, University Hospital Freiburg, Germany — Neuroimaging studies indicate that the rostral anterior cingulate cortex (rACC) is involved in affective and anxiety processing [1,2]. However, the dynamics of the rACC involvement in emotional processing and its relation to personality traits are poorly understood. To this end, the present study investigated rACC responses during the processing of repeatedly presented natural emotional stimuli in 103 healthy females and the impact of neuroticism on rACC response dynamics. Neuroticism is a personality trait that has strong association with negative emotional experience as individuals with high neuroticism scores tend to be anxious [3,4]. For stimulation during fMRI data acquisition, 30 repetitions of a movie showing crying children and 10 repetitions of a movie showing laughing children were presented. We found positive correlations with participants' neuroticism scores (Neo-FFI; [5]) and the contrast 'movie perception of crying children > baseline' for the first block in the rACC extending to the ventromedial prefrontal cortex ($p < 0.05$, FDR-corrected). Furthermore, to explore the temporal patterns in the rACC over the whole experiment a median split was conducted to divide participants into a low- and a high-anxious group. Individuals who scored high on neuroticism activated whereas low scorer deactivated the rACC at the beginning. However, this difference diminished and tended towards zero within the investigated period of time. Thus, our results indicate that future studies investigating the role of the rACC in emotional processing and anxiety disorders should take into account the possibility of differential response dynamics as a function of personality traits.

E40

CORTICO-AMYGDALAR HYPERACTIVATION IN OBSESSIVE-COMPULSIVE DISORDER DURING INDIVIDUALLY TAILORED SYMPTOM PROVOCATION Daniela Simon[1], Nele Adler[1], Christian Kaufmann[1], Norbert Kathmann[1]; [1]Humboldt-Universitaet zu Berlin, Germany — Anxiety disorders have been linked to a hyperactivated cortico-amygdalar circuitry (e.g. Cannistraro & Rauch, 2003), but the amygdala's role in the pathophysiology of obsessive-compulsive disorder (OCD) remains to be elucidated (Rauch et al., 2003). This fMRI study investigates fronto-striatal and limbic activity of 17 unmedicated OCD patients and matched healthy controls during symptom provocation with individually selected pictorial OCD triggers. Hemodynamic responses were acquired (1.5T, EPI, TR=2120ms, 38 slices, 3x3x3mm voxel) while participants performed two tasks, one self-referential, the other not, in response to OCD-relevant, aversive and neutral control stimuli presented in an event related design. During the self-referential task participants indicated how the pictures made them feel (pleasant vs. unpleasant), whereas during a demanding central distraction task processing of OCD triggers occurred outside the focus of attention. Patients showed increased fronto-striatal activation to OCD-relevant stimuli contrasted with both control categories in the self-referential task only. Symptom-related triggers elicited amygdala engagement in patients during self-referential mental activity.

We hereby confirm findings of amygdala activation previously reported during provocation in unmedicated patients with contamination fear (van den Heuvel, et al., 2004) and in a multisymptomatic sample (Simon et al., 2010). The involvement of the amygdala in the perception of disorder-relevant stimuli is consistent with its pivotal role in the detection of salient stimuli (Sergerie et al., 2008). However, attention-demanding tasks seem to attenuate emotional processing in OCD patients. We present evidence for a putative link between pathological anxiety in OCD and fronto-limbic activation, which provides a link to other anxiety disorders.

E41

ANXIETY-RELATED AMYGDALO-INSULAR ANTICIPATORY RESPONSE TO AN AVERSIVE SOUND Joshua Carlson[1], Tsafrir Greenberg[1], Denis Rubin[1], Lilianne Mujica-Parodi[1]; [1]State University of New York at Stony Brook — Anticipation is a central component of anxiety and the anterior insula appears to be an important neural substrate in which anxious anticipation is mediated. However, the extent to which individual differences in trait anxiety are associated with anticipation-related reactivity to aversive sounds is unknown. Based on previous findings in other sensory modalities, we hypothesized that the anterior insula, amygdala, and anterior cingulate would be activated during the anxious anticipation of an aversive sound and this activity would be positively associated with an individual's level of trait anxiety. Thirty-five participants completed the State-Trait Anxiety Inventory and an fMRI cue (X or O; 1sec) plus countdown (16 sec) paradigm to signal a future aversive (X = 100 dB burst of white noise) or neutral (O = soft presentation of white noise) auditory event (1000 ms). Analyses revealed anxious anticipation-related activity in the right amygdala, bilateral insula, and additional structures (p's < 0.001). Aversive anticipation-related activity in the left amygdala and bilateral insula were found to covary with trait anxiety (p's < 0.005). Additionally, a subset of participants ($N = 23$) rated their anxiety levels during the period of aversive anticipation. Variability in these ratings positively covaried with activation in the visual cortex ($p < 0.005$). These findings provide evidence for an amygdalo-insular system involved in aversive auditory anticipation and that variability in amygdala and insula reactivity were associated with trait anxiety. Facilitation of visual cortex (possibly indicative of increased fear-elicited attention) was associated with participants' self-reported level of anxious anticipation.

E42

THE AFFECTIVE IMPACT OF FINANCIAL SKEWNESS ON NEURAL ACTIVITY AND PREFERENCE Charlene C. Wu[1], Peter Bossaerts[2], Brian Knutson[1]; [1]Stanford University, [2]California Institute of Technology — Traditional economic and finance theories consider the anticipation of expected value and variance, but few have targeted the influence of improbable but significant outcomes (i.e., "skewness"). Employing a gambling task with event-related fMRI, this study investigated whether anticipatory neural activation and reported affect in response to financial skewness can account for subsequently observed gamble preferences. Participants ($n=18$) played 4 different gambles that were constructed with equivalent expected value but varied systematically by variance (high versus low) and skewness (positive versus negative). Following scanning, participants reported their valence and arousal as well as ranked their preferences for each gamble. Despite equivalent financial returns across gambles, participants displayed distinct preferences, preferring high variance and positively skewed gambles while avoiding the negatively skewed gamble. Consistent with previous studies of monetary anticipation, expected value elicited activation in nucleus accumbens (NAcc) and medial prefrontal cortex (MPFC), whereas variance elicited activation in the anterior insula (Kuhnen & Knutson, 2005; Preuschoff, Bossaerts & Quartz, 2006). Relative to a gamble with equal variance, both positively and negatively skewed gambles elicited heightened anterior insula activation. Finally, reported affective positivity correlated with NAcc and MPFC activation. Collectively, these findings support an anticipatory affect account (Knutson & Greer, 2008) in which statistical properties of gambles - including skewness - influence preferences by their affective impact. Neither traditional expected value nor mean-variance models can account for the observed neural or behavioral results. Neuroeconomic studies can inform existing economic models by disentangling and reconstructing the psychological and neural components that promote choice.

E43

NEURAL MECHANISM MEDIATING THE STATUS QUO BIAS Rongjun Yu[1], Dean Mobbs[1], Ben Seymour[2], Andrew Calder[1]; [1]MRC-Cognition and Brain Science Unit, Cambridge, UK, [2]Wellcome Trust Centre for Neuroimaging, University College London, UK — The reason why human have a prevailing tendency to stick with the default alterative even though it is not optimal (e.g. preferring for an incumbent candidate) has long been a puzzle to social scientists. The prevalence of such bias challenges the axiom of decision theorists which posit that only the expected utility associated with each choice matters. Using fMRI, we found that status quo modulates decisions and psycho-physiological response to outcomes. Participants played a non-social realistic gambling task in which they were first assigned to one gambling card and then asked to choose either to stay with the status quo card or switch to the other card. Although the default cards were assigned randomly, participants were more likely to stay than to switch, and the probability of stay significantly correlated with activity in insula. Subjective emotion ratings showed that participants felt stronger frustration for losses after switch than after stay. The enhanced frustration significantly correlated with elevated activity in right anterior insula and rostal anterior cingulate cortex, regions consistently been identified as responding to both physical and psychological pain. Taken together, our results illustrated that simply putting one alternative in the status quo position can dramatically bias the decisions and modulates subsequent outcome evaluation. The anticipatory somatic response to potential negative consequence after switching might underlie the defaults preference in decision making. Our study highlights the importance of considering status quo framing in public policy making and incorporating default preference within models of human decision making.

E44

FUNCTIONAL INVESTIGATION OF DYNAMIC FACIAL EXPRESSIONS Marie Arsalidou[1,2], Margot Taylor[1,2]; [1]Hospital for Sick Children, [2]University of Toronto — Humans are very effective in discerning emotions from facial expressions. Numerous studies have examined the neural correlates of facial expressions, but only few have utilized dynamic presentations, which would have intuitively much greater ecological validity. In three fMRI experiments we investigated activity elicited by (1) dynamic and static happy faces, (2) dynamic and static happy and angry faces, and (3) dynamic faces and dynamic objects. Using activation likelihood estimate (ALE) meta-analysis we also demonstrated a network of areas across studies that used dynamic facial expressions. In agreement with previous research, we showed that a set of areas underlies processing of dynamic facial expressions; these include the fusiform gyrus, middle temporal gyrus (V5/MT), superior temporal sulcus (STS) and amygdalae. We found V5/MT, STS and the amygdalae were more active for dynamic than static facial expressions. Evidence from the meta-analysis revealed concordant activity in the same regions, as well as areas associated with cognitive manipulations (inferior and middle frontal gyri) and eye movements (precentral gyrus). Thus, these findings demonstrate that dynamic facial expressions draw on a distributed set of structures that include those elicited by static facial expressions, and also show increased activity in a wider network of areas involving the amygdalae and STS, likely related to their increased salience.

E45

SEX STEROID INFLUENCES ON SOCIAL REWARD PROCESSING Lena Rademacher[1,2], Sören Krach[3], Frieder Paulus[3], Gerhard Gründer[1,2], Katja N. Spreckelmeyer[1,2]; [1]RWTH Aachen University, [2]JARA-Translational Brain Medicine, [3]Philipps-University Marburg — Gonadal steroid hormones have been shown to modulate reward-related neural activity (Dreher et al., 2007). The aim of the present study was to examine specifically, if gonadal steroid levels have an influence on the neural mechanisms underlying processing of social reward in the form of friendly faces. Seventeen male and 15 female participants (all heterosexual, single, nulliparous, and not taking hormonal medication) performed the "social incentive delay" paradigm (Spreckelmeyer et al., 2009) during functional magnet resonance imaging (fMRI) on a 3 Tesla scanner. In every trial a cue indicated either potential reward (three types of happy face expressions with increasing intensity level) or no reward (control trial). To test for opposite-gender effects, the colour of the cue was varied indicating either a male or female face as potential reward. In order to receive reward, a target button had to be pushed within a certain time window. Estradiol, progesterone and testosterone plasma levels were measured in all participants. Influences of hormone levels were predominantly found in male participants: amygdala activation during the anticipation of opposite-gender faces correlated with estradiol levels in men but not women. Also, we found a positive correlation between male testosterone levels and insula activity during the presentation of same-gender (i.e. male) faces in the reward consumption phase. The data suggest that hormonal levels influence the processing of social reward in a gender-specific manner. The results allow inferences on hormonal regulation of socio-sexual approach behavior.

E46

THE EFFECTS OF SOCIAL RELATIONSHIPS ON NEURAL ACTIVITY DURING A COOPERATIVE GAMBLING GAME Michael A. Niznikiewicz[1], Dominic S. Fareri[1], Victoria K. Lee[1], Mauricio R. Delgado[1]; [1]Rutgers University — Research has demonstrated involvement of the striatum in processing positive and negative outcomes in both non-social and social domains (Elliott et al., 1998; Delgado et al., 2000; Seger et al., 2005; Izuma et al., 2008). An outstanding question is how the quality of our social relationships may modulate this processing. This study seeks to explore the effects that social relationships may exert on neural activity during a cooperative gambling game, where participants' role (i.e., playing or observing a partner play) and partner (computer, stranger and a close friend) varied. The goal of the game was to win money by correctly guessing whether a cue card had a high or low value. Participants played with three partners: a computer, a stranger, and a close friend, each represented by a picture shown above the cue card. Their role switched across runs from the person making the guesses (actor), to observing their partners' guesses (observer). At the end of the game, the participant split his or her winnings from all blocks evenly with each partner. As in previous iterations of this gambling task (e.g., Delgado et al., 2000), preliminary analysis revealed a main effect of feedback in the ventral striatum, showing increased BOLD activity to positive outcomes. Interestingly, this response was modulated by an interaction of role and partner, specifically in the observer role. Future analysis will explore the involvement of other regions implicated in reward and social processing, such as the amygdala.

E47

A DISPOSITION TO REAPPRAISE DECREASES INSULA REACTIVITY DURING AVERSIVE ANTICIPATION Nazli Dikecligil[1], Josh Carlson[1], Lilianne Mujica-Parodi[1]; [1]State University of New York at Stony Brook — The anticipation of aversive events or outcomes is a central component of anxiety-related behaviors and disorders. Research indicates that the anterior insula is involved in anticipatory threat processing and representing emotional states. The reappraisal of negative emotional stimuli generally decreases amygdala and insula activation and may therefore decrease negative/anxious emotional processing. However, the extent to which individual differences in dispositional reappraisal are associated with anticipation-related insula reactivity is unknown. Based on previous findings, we hypothesized that the anterior insula, amygdala, and prefrontal cortex would be activated during the anxious anticipation of an aversive image and that activity in these structures would be negatively associated with the extent to which an individual reappraises emotional stimuli in daily life. Twenty participants completed the Emotion Regulation Questionnaire (Gross & John, 2003) and an fMRI cue (X or O; 1sec) plus countdown (16 sec) paradigm to signal a future aversive (X) or neutral (O) image (IAPS; 3000 ms). Analyses revealed anxious anticipation-related activity in the left anterior insula, left dorsolateral prefrontal cortex, and bilateral areas of visual cortex (p's < 0.001). Aversive anticipation-related activity in the right anterior insula was found to negatively covary with reappraisal (p's < 0.001). These findings provide further evidence that the anterior insula is involved in aversive anticipation and that variability in anticipatory insula reactivity is negatively associated with reappraisal. Thus, a disposition to reappraise may decrease negative emotional states of anticipation.

E48

BOTH PAIN AND NEGATIVE EMOTION ACTIVATE PERIAQUEDUCTAL GRAY Jason Buhle[1], Hedy Kober[2], Kevin Ochsner[1], Peter Mende-Siedlecki[3], Brent Hughes[4], Tor Wager[1]; [1]Columbia University, [2]Yale University, [3]Princeton University, [4]University of Texas - Austin — An extensive animal and human literature has characterized the descending inhibition periaqueductal gray (PAG) exerts on ascending nociceptive input. This inhibition has been shown to mediate diverse anti-nociceptive mechanisms, including opioid drugs, placebo expectancy, and distraction. Additionally, PAG receives direct projections from ascending nociceptive pathways in the spinal cord, and human neuroimaging studies reliably report pain-related increases in PAG activity. Yet the function of PAG appears to extend well beyond pain processing. Animal studies indicate PAG participates in the coordination of behavioral and physiological responses to threat, including aggression, fear, and learned helplessness, and recent neuroimaging meta-analyses have found consistent activation of the PAG during negative emotional processing unrelated to nociception. In the present study, we interleaved phasic heat stimulation and presentation of emotional photographs during a single fMRI session to directly compare neural activity associated with and pain and negative affect. PAG activity was greater during high compared to low pain and negative compared to neutral image viewing. Follow-up connectivity analyses examined relationships between PAG and other pain- and affect-processing regions as a function of stimulus type. To our knowledge, this study provides the first within-subject confirmation of a shared role for PAG in pain and negative emotion. These findings suggest that cognitive neuroscience models of emotion should incorporate PAG as a core region in the generation of negative emotion.

E49

SEX HORMONES AND THE PERCEPTION OF INFANT FACES Janek Lobmaier[1], Reiner Sprengelmeyer[2], David Perrett[2]; [1]University of Berne, Switzerland, [2]University of St. Andrews, UK — Interactions between a mother or father and a newborn are probably the most elementary of all human interactions. Given this high biological and psychological relevance, the scarcity of work on perception of infant faces is surprising. In a series of studies we investigated emotive responses to infant faces. We compared the sensitivity of young males and females to computer-manipulated baby faces varying in cuteness. In a two alternative forced choice experiment participants had to choose the baby which they thought was cuter. In general, females were more sensitive to variations in cuteness. Women taking oral contraception outperformed women not taking contraception. These results suggest an existence of a hormone-modulated visual system for perceiving cuteness, which works highly efficiently in women of childbearing age. In a second experiment with the same stimulus material participants were asked to choose the younger infant. Here we found no group differences between males and females regarding accuracy. Different accuracy in cuteness ratings but not in the age judgements indicates that males might use different cues when processing cuteness of infant faces. While females pick up on more "holistic" neotenous cues to judge cuteness, males seem to base their judgements on other cues, such as for example emotional expression. Given that cuteness is considered an indicator of being helpless and in need of care, we hypothesise that the ability to detect small variations in the degree of cuteness may have evolved to guide the allocation of necessary maternal care to the infant.

E50

DISSOCIABLE FMRI ACTIVATION PATTERNS ASSOCIATED WITH BASIC EMOTION STATES Katherine Vytal[1], Stephan Hamann[1]; [1]Emory University — Ekman (1999) proposed that basic emotion states (i.e., happiness, sadness, anger, fear, and disgust) elicit characteristic and distinctive patterns of physiological and CNS activity. A recent quantitative meta-analytic review (Vytal & Hamann, in press) examined multiple neuroimaging studies and found that basic emotion states are associated with characteristic and dissociable activation patterns. However, the question of whether such dissociable activation patterns exist has not been investigated previously by directly contrasting each basic emotion within a single FMRI study. We used functional magnetic resonance imaging (fMRI) to scan participants while they experienced basic emotion states elicited during alternating runs of films and autobiographical memories. Eleven subjects (5 female) were scanned while they viewed 20-second film clips and recalled 30-second autobiographical memories (from each basic emotion category, alternating with neutral emotion). During each trial, subjects made a button press when they first began to feel an emotional response. Following each trial, subjects rated their elicited emotional state on valence, arousal, and emotion category. Ratings confirmed that the emotional stimuli were effective in eliciting the intended emotional responses. Results demonstrated that each basic emotion state elicited a distinctive and characteristic pattern of activation (e.g., happiness: anterior cingulate, sadness: subgenual cingulate, disgust: insula) regardless of the elicitation method used. Additional regional activations were also associated with elicitation method (film vs. memory). These findings converge with previous evidence from neuropsychology and other domains and provide further support the proposal that basic emotions are associated with characteristic patterns of neural activation.

E51

PSYCHOPHYSIOLOGICAL STATES DISCRIMINATE BASIC EMOTIONS Jennifer Wilson[1], Stephan Hamann[1]; [1]Emory University — The existence of emotion-specific physiological activity is a central element of theories of discrete or basic emotion. Patterns of physiological activity that can consistently differentiate between emotions across multiple contexts have not yet been identified. This study investigated whether anger, fear, disgust, happiness, and sadness could be discriminated on the basis of cardiorespiratory activity, and whether this generalized across two different methods of emotion elicitation. Electrocardiogram, impedance cardiogram, and respiratory activity were recorded while participants either recalled autobiographical memories or watched film clips designed to elicit the target emotions and a neutral state. Heart rate, heart rate variability, respiratory sinus arrythmia, and respiration rate, amplitude, and variability were assessed. Participants' subjective ratings of their emotional responses confirmed that both recollection and film clips elicited strong emotional responses consistent with the targeted emotion. Univariate analyses indicated strong effects of emotion on respiration frequency, and smaller effects on heart rate and heart rate variability. Principal components analysis reduced overlap in variance among cardiorespiratory variables, and MANOVA revealed significant increases along the respiration component in Happiness and Fear relative to Disgust in the emotional recall condition. Discriminant analyses tested the ability to discriminate among emotions in the emotional recall condition, based on the pattern of cardiorespiratory components observed for each emotion type. Resulting discriminant functions allowed emotion classification at a rate significantly above chance. These findings suggest that characteristic physiological responses for each basic emotion remain constant across methods of elicitation.

E52

THE ROLE OF ATTENTION IN EMOTION REGULATION SUCCESS Genna Bebko[1], Steven Franconeri[1], Kevin Ochsner[2], Joan Chiao[1]; [1]Northwestern University, [2]Columbia University — Cognitive reappraisal successfully regulates emotions by decreasing negative emotional experience without physiological or mental costs (Gross, 2007). According to appraisal theories of emotion, cognitive change processes underlying reappraisal play an important role in reappraisal success because changing thoughts can successfully change feelings (Lazarus, 1991). In opposition to this theory, a neuroimaging study found that gaze accounted for significant variance in neural activity associated with reappraisal success, suggesting that attentional deployment processes may play a larger role in reappraisal success than cognitive change processes (van Reekum, et al., 2007). When gaze is controlled, however, reappraisal is still successful, suggesting that attentional deployment may not be a causal mechanism for reappraisal success (Urry, 2009). The purpose of this study was to further examine the relationship between attentional deployment and emotion regulation success. Participants were randomly assigned to either a reappraise (N=43; 22 females) or suppress (N=41; 19 females) group. We controlled the valence of attentional focus while participants viewed negative IAPS images during emotion regulation. To measure emotional experience after each trial, participants rated how negative they felt. Consistent with findings from prior studies, reappraisers rated feeling significantly less negative than suppressers (Gross, 2007). Furthermore, participants rated feeling significantly less negative after emotion regulation relative to after baseline (attend). Novel to this study, we found that varying the valence of attentional focus did not alter the success of cognitive reappraisal or expressive suppression. These findings provide further evidence against the role of attentional deployment as a causal mechanism for emotion regulation success.

E53

THE PRIMACY OF NEGATIVE INTERPRETATIONS WHEN RESOLVING THE VALENCE OF AMBIGUOUS FACIAL EXPRESSIONS Maital Neta[1], Paul Whalen[1]; [1]Dartmouth College — Surprised facial expressions can be interpreted either positively or negatively. We have previously shown that a region of the ventromedial prefrontal cortex and the amygdala show inverse activity in response to surprised faces that predicts whether the face will be interpreted as negative or positive. Specifically, high prefrontal activity and low amygdala activity predicts a positive interpretation. We speculated that surprised expressions are initially processed in terms of their potential negativity, and a positive interpretation requires additional processing/regulation. As an initial behavioral test of this idea, we examined the effect of spatial frequency information on valence interpretations of surprised expressions. It is widely accepted that coarse, low spatial frequency features are processed first and that this is followed by a finer analysis of high frequencies. Further, recent data show that the amygdala is particularly responsive to LSF information contained within negative facial expressions. We reasoned that LSF presentations of surprised faces would be more likely to be interpreted negatively, given the bias of the amygdala in this direction. To this end, we had subjects provide valence ratings of surprised expressions presented as only LSF information, only HSF information, or intact images. Results showed that surprised expressions were interpreted as more negative and reaction times were faster to LSF information compared to HSF information. These data are consistent with our proposal that the default hypothesis for surprised expressions is to interpret them as negative at first, and that positivity requires regulation based upon more detailed features (i.e., HSF information).

E54

STRESSED BY THE OPPOSITE SEX: IMPACT OF THE COMMITTEE'S SEX ON STRESS REACTIVITY IN MEN AND WOMEN Annie Duchesne[1], Eyerusalem Tessera[1], Jens Pruessner[1]; [1]Douglas Mental Health Institute, McGill University — Stress response to a psychosocial challenge shows consistent sex difference, where men are typically more reactive compared to women. Gonadal hormones only partially contribute to the observed discrepancy between men and women. Sex differences in processing social information have also been reported. In fact, in stressful situations women would try to bond with other women as opposed to men who inversely represent a source of threat suggesting that social evaluation provided by either men or women might differentially modulate the stress response. This study investigates the impact of the panel's sex on the stress reactivity of men and women to a psychosocial challenging task. Men and women between 18 and 25 years of age were exposed the Trier Social Stress Task in front of a committee comprised of only men, or only women. Women were equally tested during their cycle. Salivary cortisol, blood pressure and perceived stress were measured throughout the task. Cortisol levels measured by the area under the curve increase (AUCi) were significantly increased when both men and women were exposed to an opposite sex panel. However, while this effect seems to be driven by menstrual cycle in women, variation in personality components seems to contribute to the effect in men. This study demonstrate the effect of the committee's sex during a social evaluative stress task and both men and women were more reactive to an opposite sex panel. Although the same results are observed in men and women the underlying factors seem to be different.

E55

THE P300 AS A MARKER OF COLLECTIVE GUILT IN A MOCK INTERGROUP TRANSGRESSION Eric Vanman[1], Martin Henrion[1]; [1]School of Psychology, University of Queensland, Australia — Collective guilt is a negative feeling associated with wrongful actions perpetrated by one's social group on members of another group. It traditionally has been investigated in the context of historical conflicts between real groups using questionnaires. This study investigated whether an event-related potential (ERP) version of the Guilty Knowledge Test, which was developed for lie detection, could also be used to measure collective guilt in a laboratory paradigm. University students participated in a two-part experiment. In the first session, they were assigned arbitrarily to one of two teams and then engaged in team-building exercises, which included creating a team flag. Collective guilt was manipulated by having a confederate, who was randomly assigned to one of the teams, destroy the other team's flag "by accident." Thus, some participants were now associated with the perpetrator's group and the others were associated with the victim group. In the second session, participants completed a picture-viewing task while ERPs were recorded. Analyses revealed that participants in the victim group elicited larger P300s when viewing task-relevant stimuli (e.g., a picture of the damaged flag) than did those in the perpetrator group. Consistent with hypotheses, however, a strong positive correlation between self-reports of collective guilt and P300 amplitude was observed when participants in the perpetrator group viewed such stimuli. The relationships between self-report measures of emotion and P300 amplitudes to transgression-related stimuli demonstrated validity for this new measure of guilt. This study also provides a laboratory-based procedure for investigating collective guilt in social situations.

E56

THE PROCESSING OF FACIAL EXPRESSIONS DURING PAIN Antje B. M. Gerdes[1], Matthias J. Wieser[1], Rene Greiner[1], Paul Pauli[1]; [1]University of Würzburg, Germany — It is well known that emotion modulates pain perception. In order to test whether pain can also influence emotion processing, happy, angry and neutral facial expressions were presented to 40 healthy volunteers during either painful or non-painful pressure stimulation. Subjective ratings of valence and arousal and event-related brain potentials (ERPs) in response to facial expressions were measured. Overall, early visual components (P100, N170) were not modulated by the facial expressions. However, during pain the amplitude of the P100 was significantly reduced in response to all facial expressions. At later stages of stimulus processing, angry and happy facial expressions elicited augmented late positive potentials (LPP) relative to neutral expressions, and this index of a more elaborated perceptual analysis was also reduced during pain independently of the facial expression. Explicit ratings of the facial expressions were not affected by pain. Thus, pain generally reduces early and late components of central nervous face processing, but does not interfere with the processing of specific facial expressions. In sum, the results indicate that pain captures and maintains attention resulting in an overall reduced processing of facial expressions.

E57

ATTACHMENT ANXIETY, RESPONSIVENESS, AND REWARD SYSTEM FUNCTIONING Joshua Poore[1,2], Matthew Lieberman[2], Jennifer Pfeifer[3], Elliot Berkman[2], Tristen Inagaki[2]; [1]National Institute of Neurological Disorders and Stroke, [2]University of California, Los Angeles, [3]University of Oregon — Neurobiological animal models of monogamous pair-bond formation have been influential in the understanding of human romantic attachments. However, they have not yet accounted for the propensity of the human attachment system to adopt cognitive/behavioral care-seeking styles that are tailored to the patterns with which romantic partners are responsive. Given 1) the importance of the mesocorticolimbic reward system in the development of partner preferences in animal models, 2) its functional similarities with the attachment system, and 3) its relation to uncertainty-related phenomenology also associated with the anxious attachment style, we examined whether the mesocorticolimbic reward system might be involved in the adoption of the attachment styles in relation to partner responsiveness. Participants were given 100 statements that either confirmed their expectations about their partners' romantic sentiments or violated them, with roughly equal likelihood, at near chance levels. Findings show that ventral tegmental activity systematically tracked the valence of the statements. Also, consistent with prediction-error studies of economic losses relative to gains, the posterior ventral striatum showed activity when expectations were negatively violated, rather than positively violated. Additionally, activity in the anterior ventral striatum and medial orbitofrontal cortex was associated with task-related attachment anxiety. Overall, findings suggest that the human reward system tracks stimuli related to partner responsiveness and monitors violations of expectations for responsiveness. Given that the reward system is also an associative behavioral learning system, our findings suggest that it may be involved in the attachment system's ability adopt styles of care-seeking behavior based on partners' patterns of responsiveness.

E58

INFLUENCE OF GENDER AND INDIVIDUAL PREFERENCE ON NEURAL ACTIVITY DURING SOCIAL REWARD PROCESSING Katja Spreckelmeyer[1], Lena Rademacher[1], Soeren Krach[2], Gregor Kohls[3], Gerhard Gruender[1]; [1]RWTH Aachen University, Germany, [2]Philipps-University Marburg, Germany, [3]Children's Hospital of Philadelphia — Social feedback is a strong motivator for human behaviour. In a number of consecutive studies we delineated the neural correlates of goal-directed behaviour towards social incentives. Specifically, we examined the neural basis of reward anticipation vs. consumption in an incentive delay task offering different levels of social approval. In study 1 (performed on a 1.5T fMRI scanner in N=28 participants) we also offered monetary reward for direct comparison of different incentive types. In study 2 (performed on a 3T scanner in N=30 participants), only social reward was offered but came either from a male or a female person to test for opposite-gender effects. Both studies revealed activation of the ventral striatum during anticipation of reward, which increased with increasing level of reward, independent of incentive type. However, neural activation during anticipation was modulated by gender in a complex manner. Sensitivity to anticipated social reward was stronger in women than men only if monetary reward was offered within the same experiment, the latter yielding much stronger activations in men than women. If only social reward was offered (study 2) striatal activations were equally pronounced in men and women. However, in the same study, the amygdala of male participants was found sensitive to increasing levels of anticipated social feedback if it came from a woman. In both studies, reward consumption led to pronounced amygdala activation in response to social feedback. Again, amygdala activation was modulated by reward level. The findings imply sensitivity to reward value in different structures of the reward system.

E59

ANXIETY MODULATES RESTING STATE FUNCTIONAL CONNECTIVITY OF THE AMYGDALA AND THE MEDIAL PREFRONTAL CORTEX M. Justin Kim[1], Dylan G. Gee[2], Rebecca A. Loucks[1], Paul J. Whalen[1]; [1]Dartmouth College, [2]University of California, Los Angeles — Evidence from nonhuman animal and human research suggests that anxiety is related to a number of cortical and subcortical brain regions, particularly the amygdala and the dorsal and ventral portions of the medial prefrontal cortex (mPFC). Given that anxiety is an ongoing psychological state, we hypothesized that anxiety levels would modulate the functional connectivity of these brain regions during rest, even without the presence of anxiety-inducing external stimuli. Resting state functional magnetic resonance imaging scans and self-reported measures of anxiety were acquired from a total of 29 healthy subjects. Using a seed-based approach, statistical maps of the brain showing voxels that correlated with the intrinsic spontaneous low-frequency signals within the amygdala were computed for each individual subject. At the group level, anxiety measures were included to generate maps of regions that covaried in connectivity with the amygdala. We found a significant positive correlation between state anxiety and functional connectivity of the right amygdala with the dorsal mPFC and a negative correlation with the ventral mPFC. Taken together, our data show that anxious subjects, even during rest, recruit an amygdala-mPFC circuitry that has been implicated in generating and controlling anxiety. Interestingly, we demonstrated a dissociation between dorsal mPFC versus ventral mPFC functional connectivity and anxiety.

E60

MUSICAL CHILLS: LINKING EMOTION AND PLEASURE IN THE BRAIN Valorie N. Salimpoor[1,2,3], Mitchel Benovoy[3,4], Alain Dagher[1], Robert J. Zatorre[1,2,3]; [1]Montreal Neurological Institute, McGill University, [2]BRAMS Laboratory, [3]Centre for Interdisciplinary Research in Music Media and Technology, [4]Centre for Intelligent Machines, McGill University — Emotion and reward have long been associated, but how emotions become pleasurable is not entirely clear. Music provides an excellent medium to examine this relationship, since (1) music can be both pleasurable and emotionally arousing; (2) the pleasurable aspects of music are thought to result from emotional arousal; and (3) the temporal and dynamic nature of musical stimuli allow for an examination of build-up in emotional arousal and how this may contribute to pleasure. In contrast to previous fMRI experiments that have used experimenter-selected music, we used self-selected music, thereby allowing for a fuller range of emotional experience. The "musical chills" response, a marker of peak autonomic nervous system activity, was used to index intense emotional arousal. Functional MRI scans were collected as individuals listened to music while providing continuous subjective ratings of pleasure. A parametric analysis confirmed that voxels showing a correlation with increases in subjective pleasure were found in dorsal and ventral striatal regions implicated in reward and motivation, consistent with previous studies. However, this study offers the novel finding that peak periods of emotional arousal were also associated with activity in these regions, providing a direct link between emotional arousal and pleasure during music listening. Moreover, time-series analysis revealed distinct patterns of activity in different portions of striatal, limbic, and frontal regions during periods leading up to the peak of emotional arousal as opposed to during and after this moment, providing a glimpse of how a build-up in emotional arousal can lead to pleasurable feelings.

E61

PERIPHERAL EMOTION PROCESSING: EFFECTS OF FACIAL EXPRESSIONS IN A CLINICAL POPULATION Simon Rigoulot[1], Fabien D'Hondt[1], Sabine Defoort-Dhellemmes[1], Pascal Despretz[1], Jacques Honore[1], Henrique Sequeira[1,2]; [1]University of Lille, France, CNRS UMR8160, [2]University of Lille — The visual detection of natural emotional scenes constitutes an essential adaptive ability. However, human visual capacities are not homogeneous depending on which part of the visual field is stimulated. Indeed, it is generally admitted that visual performance declines with the visual field eccentricity, from central to peripheral vision (CV, PV). When CV capacities are reduced or even abolished, as is the case in patients with central scotomas, visual resources are limited to those of PV. Then, it appears important to improve such resources. As suggested by recent studies, one way could consist to displace attentional focus on peripheral visual field. Considering the ability of emotional information to capture attentional resources, even in degraded visual conditions similar to those in PV, we tested for the first time the performance of patients' PV to the presentation of neutral and emotional facial expressions. Happy, fear or neutral faces were presented to the PV of 7 patients with impaired central vision. Patients had to discriminate faces according to their expression, emotional or not. The analyses of variance, conducted on the percentage of correct responses showed patients are more efficient in VP for emotional faces than neutral, especially for happy ones. This result suggests that happy faces might be used to increase the attentional capture in PV and then contribute to optimize the performance of PV in patients with lesions or diseases of the CV. Consequently, these data open new perspectives on the behavioral rehabilitation of CV disorders like Age-related Macular Disease or Stargardt's Disease.

E62

EMPATHIC DYSFUNCTION AND ABNORMAL EMOTION PROCESSING IN INCARCERATED PSYCHOPATHS Laurie R. Skelly[1], Kent A. Kiehl[2,3], Jean Decety[1]; [1]University of Chicago, IL, [2]Mind Research Network, Albuquerque, New Mexico, [3]University of New Mexico, Albuquerque, New Mexico — Psychopathy is a personality disorder believed to be a contributing factor to a disproportionate amount of serious societal problems such as violent, recidivistic crime and fraud. Though conventional wisdom predicts that psychopathy is characterized by serious deficits in emotional functioning including empathy and sympathetic concern, studies to date have had difficulty finding consistent differences between psychopaths and controls in traditional probes of emotion functioning. The current study aims to investigate emotion perception and empathy in criminal psychopaths with greater sensitivity by (1) using criminal psychopaths who score very high on the Hare Psychopathy Checklist-Revised, (2) comparing them with an appropriate, well-matched criminal control group, and (3) isolating neural differences associated with empathy and emotion processing by using a passive viewing paradigm that limits the effects of cognitive compensation strategies that may mask differences in emotion-naming, priming, and self-report. Twenty incarcerated, male psychopaths and twenty incarcerated controls, matched for age, IQ, and substance abuse, viewed depictions of social interactions and dynamic expressions of emotion in the Mind Research Network's Mobile 1.5 Tesla MR scanner stationed at the maximum security prison. Results reveal intriguing differences in cortical and subcortical regions during emotion processing, including patterns of activation in the amygdala between groups in the reverse pattern expected by contemporary theory.

E63

HEMISPHERIC DIFFERENCES IN PROCESSING FACIAL AFFECT: THE PARANOIA EFFECT Yuan Hang Li[1], Xin Ming An[1], Eran Zaidel[1,2]; [1]Psychology, UCLA, Los Angeles, CA, [2]Brain Research Institute, UCLA, Los Angeles, CA — INTRODUCTION: Behavioural, as well as neurophysialogical data, show that 1) the Right Hemisphere (RH) is specialized for processing facial affect and 2) the RH is specialized for processing negative affect (the valence hypothesis). However, the majority of studies have only employed full emotional face stimuli as oppose to emotional expressions with a range of intensities. METHODS: We used emotional face stimuli of anger and happiness that were morphed with neutral faces. Participants indicated with 2 alternative forced choice bimanual button presses whether the stimulus was angry/happy or neutral. Stimuli were flashed centrally or to the left or right visual hemifield for 150ms. RESULTS: We conducted a 3 (VF: left, right, center) x 2 (emotion: angry, happy) x 2 (intensity: low, high morph) repeated measures ANOVA. There was a significant 3 way interaction showing a selective LH advantage for identifying low intensity angry morphs. DISCUSSION: Our results do not conform to either the RH being specialized for processing facial affect or to the valence hypothesis of hemispheric specialization for negative affect. When detecting angry stimuli, there is a selective Left Hemisphere (LH) strategy that interprets neutral facial affect as angry. We refer to this as "the Paranoia Effect." CONCLUSION: The LH is more biased than the RH to see anger in faces of strangers when they express little or no anger.

E64

THE WARM GLOW OF SELFISHNESS: SELF-INTEREST VALUE IS ASSOCIATED WITH INCREASED STRIATAL ACTIVATION TO REWARD Tobias Brosch[1,2], Geraldine Coppin[1], Klaus Scherer[1], Sophie Schwartz[1], David Sander[1]; [1]University of Geneva, [2]New York University — Although every human being – and every organism – must to a certain degree prioritize the pursuit of their own interests in order to survive, people differ in how much importance they give to the pursuit of self-interests. We investigated the neural mechanisms underlying decisions affected by an individual's dominant values, comparing participants who reported privileging either self-interest or altruistic motives. Using functional magnetic resonance imaging (fMRI), we investigated the neural correlates of self-interest in a donation paradigm where 19 participants were given an amount of investment money that they were to distribute between themselves and a charitable organization of their choice. Selfish individuals sacrificed less money for donations to charitable organizations, showed lower activity of the "mentalizing network" when deciding about donations and higher activation of the striate reward system when receiving monetary rewards for themselves. These findings point to neural mechanisms that might underlie the effect of dispositional factors, such as values, attitudes, or personality on important behavioral decisions. Selfishness as a disposition might be caused by habitually stronger activation of the reward circuits, due to genetic or epigenetic factors, which would lead to a more positive evaluation of prospective self-interest outcomes in behavioral decisions and consequently an increased choice of selfish alternatives.

E65

VOICES OF DISGUST IN THE BRAIN Basia Radlinska[1,4], Marc Pell[1,3], G. Bruce Pike[3,4], Ekaterini Klepousniotou[2,3,4]; [1]School of Communication Sciences and Disorders, McGill University, Canada, [2]Institute of Psychological Sciences, University of Leeds, UK, [3]Centre for Research on Language, Mind and Brain, McGill University, Canada, [4]McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University, Canada — Recognising basic emotions such as 'fear' or 'disgust' is thought to engage distinct brain networks, based on mounting lesion and neuroimaging data. Specifically, disgust may selectively engage the insula and basal ganglia structures (putamen, caudate), among other regions involved in emotional processing. However, few studies have examined the processing of disgust conveyed in speech (emotional prosody). This study investigated the neural correlates of implicit attention to vocal expressions of disgust independent of semantic meaning, using a block fMRI design. Semantically-anomalous pseudo-utterances (e.g., We revimerated the mesty yorns) produced by male and female actors to convey disgust (experimental condition) or neutrality (control condition) were presented in pairs. Sixteen young adults (8 female) were scanned while listening to each utterance pair and judging whether the speaker was the same or different (implicit emotional processing). Analyses compared conditions in which listeners processed sentences conveying disgust versus identical neutral sentences. Our analysis revealed significant bilateral activations of the middle frontal gyrus (BA 46) and the insula (BA 13), which were stronger in the right hemisphere. There was also a right-sided activation of the inferior frontal gyrus (BA 45). Furthermore, vocal cues to disgust elicited activity in the subcortical gray matter of the lentiform nucleus, complementing patient and lesion studies which point to the importance of the putamen for recognising this emotion. Our findings neatly build upon previous data describing emotion-specific neural regions implicated in the recognition and experience of disgust, extending these findings to how disgust is understood from vocal attributes of speech.

E66

AN ERP STUDY ON THE EMOTIONAL PROCESSING OF HANDWRITTEN AND PRINTED WORDS Reiko Sawada[1,2], Nobuo Masataka[1]; [1]Primate Research Institute, Kyoto University, [2]Japan Society for the Promotion of Science — When we read the letters from our friends written by hand, we are able to not only identify who wrote them but also feel a warmer impression from them compared to computer-generated letters. Some recent studies reported that handwritten words are processed differently from printed words. Event-related potentials (ERP) were recorded under three conditions of writing styles (self-generated, other-generated, and printed) to examine on emotionality on visual word processing. Fourteen volunteers (nine females and five males; average age = 30.5±7.4 yrs) were participated in this experiment. Emotional adjectives of negative and positive valence were presented in a positive/negative judgment task. We focused on early (P2) and late components (N400 and late positive component/LPC). These ERP components are recorded at central and parietal electrode sites, which are related to emotional effect on word processing. By ERP analysis, we found that faster P2 was recorded while printed words were presented compared to handwritten scripts, and there was no difference between self-generated and other-generated words. The handwritten words elicited larger N400 amplitude than the printed words and the LPC amplitude was larger for printed words than for handwritten words. These results suggested that printed words were processed faster than handwritten word. Previous studies reported that larger N400 represent greater semantic activation and LPC effect reflect mental imagery. The handwritten words yield greater semantic activation than printed words and printed words may yield more concrete or uniform imagery compared to handwritten words.

E67

EMOTION REGULATION BY COMPLEX VERBAL STIMULI: A CROSSMODAL PRIMING TASK Beate Czerwon[1], Annette Hohlfeld[2], Heike Wiese[2], Katja Werheid[1]; [1]Humboldt-Universität zu Berlin, [2]University of Potsdam — We investigated the effect of complex verbal stimuli including structural parallelisms, on the processing of emotional information. Structural parallelisms are a main characteristic of texts like poems or prayers and typically involve repetitions of semantic, syntactic or phonological features. Recent research in social sciences has shown that structurally parallel non-verbal behaviour facilitates the synchronisation of emotion. However, experimental evidence on emotion effects of structural parallelisms is scarce. In the present study we examined the impact of verbal structural parallelisms on subsequent processing of emotional facial expressions in a cross-modal priming task. Event-related brain potentials (ERPs) were recorded while participants (n=25) classified positive, negative or neutral facial expressions as emotional or non-emotional. The faces were preceded by verbal stimuli, extracted from prayers, which were either parallel or non-parallel in structure. Analysis of ERP data revealed increased amplitudes of the early posterior negativity (EPN) and a decreased late positive potential (LPP) on positive faces preceded by structural parallel primes. Our findings suggest that structural parallelisms facilitate both early and late processing of positive emotional information.

E68

SUSTAINED PREFERENTIAL PROCESSING OF ANGRY FACIAL EXPRESSIONS IN SOCIAL ANXIETY: EVIDENCE FROM STEADY-STATE VISUAL EVOKED POTENTIALS Matthias J. Wieser[1], Lisa M. McTeague[1], Andreas Keil[1]; [1]University of Florida — Social anxiety has been related to dysfunctional patterns of attention allocation to social threat cues (e.g., angry facial expressions). In the present study, continuous fluctuations of electrocortical facilitation were investigated during competition of two simultaneously presented facial expressions (angry, happy, neutral) in high and low socially anxious individuals, as determined by a prescreening procedure using the Liebowitz Social Anxiety Scale. In each trial, the two facial expressions were flickered at two different frequencies (14 Hz and 17.5 Hz, "frequency-tagging"), to separate the electrocortical signals evoked by the competing stimuli. It was found that angry faces compared to happy and neutral expressions were associated with greater electrocortical facilitation over visual areas only in the high socially anxious individuals. This pattern of results was independent of the respective competing stimulus. Heightened electrocortical engagement in the socially anxious participants was present in the first second of stimulus array presentation, and was sustained for the entire viewing period. No evidence of later avoidance of threatening faces or competition effects was found. These results, based on a continuous measure of attentional resource allocation, support the view that social anxiety is associated with early and sustained prioritized processing of social threat cues. These cues, however, do not interfere with the electrocortical processing of a concurrent face, suggesting that they are effective at capturing attention, but are weak competitors for resources.

E69

HUMOUR APPRECIATION AND THE BRAIN'S REWARD SYSTEM: IS FUNNINESS REWARDING? Mandana Modirrousta[1], Darren W. Campbell[1], Marc G. Wallace[1], Jeffrey P. Reiss[2], Joseph O. Polimeni[1], Nancy A. McKeen[1,3], Jitender Sareen[1]; [1]University of Manitoba, [2]University of Western Ontario, [3]Cancer Care Manitoba — Humour is a fundamental cognitive emotional process. From the involvement of humour in social interactions to its influence on mood and arousal, it is intrinsically linked to basic human functioning. Despite the importance of humour, the neural correlates of humour appreciation have received little systematic investigation. Previous research findings suggest a role for the brain reward centers in humour appreciation. Using functional imaging methods, we investigated the set of brain structures associated with reward processing during a humour appreciation task. Our regions of interest consisted of subcortical reward nuclei including the substantia nigra (SN), the ventral tegmental area (VTA), the nucleus accumbens (NAcc), and the amygdala, as well as cortical regions including the ventromedial prefrontal cortex and the dorsal anterior cingulate cortex. Healthy adult volunteers (N=22) were presented with 120 comics in a pseudorandom order in the scanner. Participants were instructed to indicate whether the comic was a funny joke, a joke but not funny, or not a joke through button pressing. We found that funny jokes as compared to non-funny jokes were associated with higher mean bold signal in the left amygdala, left and right SN and left and right NAcc. Furthermore, the activation in the left amygdala was positively correlated with subjective rating of 'social humour productivity' and 'using humour as a coping strategy'. Humour appreciation appears to modulate activity in the sub-cortical reward structures, yet has negligible effects on higher order reward areas within the prefrontal cortex.

E70

NEUROMAGNETIC DYNAMICS OF EMOTIONAL PROCESSING: AROUSAL AND VALENCE EFFECTS Fabien D'Hondt[1], Maryse Lassonde[2,3], Olivier Collignon[2], Simon Rigoulot[1], Jacques Honoré[1], Franco Lepore[2], Henrique Sequeira[1]; [1]Laboratoire de Neurosciences Fonctionnelles & Pathologies, CNRS UMR 8160, Université Lille Nord de France, Lille, France, [2]Centre de Recherche en Neuropsychologie et Cognition (CERNEC), Université de Montréal, Montreal, Canada, [3]Centre de recherche CHU Sainte-Justine, Montreal, Canada — A growing number of studies in affective neuroscience sought to identify the neural correlates of emotional processing by exploring arousal and valence effects, considered as primary dimensions of human emotions. In particular, neuroimaging and electrophysiological experiments have suggested that these dimensions would specifically impact brain activity during affective pictures perception. However, spatio-temporal dynamics of brain implication in arousal and valence processing remain unclear. Thus, the present study recorded event-related magnetic fields (ERFs) during the presentation of emotional (unpleasant and pleasant) and neutral pictures in 18 healthy volunteers, which had to try to experience feelings induced by those pictures. Neuromagnetic data were analyzed by means of spatio-temporal Principal Component Analysis (stPCA) and sources localization was performed using a minimum-norm analysis. Main results revealed an arousal effect, indicated by a greater activity for both unpleasant and pleasant pictures compared to neutral ones, on an occipito-temporal neuromagnetic component between 170 and 200 ms after pictures presentation. Valence effect, corresponding to a significant difference of activity between pleasant and unpleasant pictures, was observed on a fronto-temporal neuromagnetic component between 240 and 380 ms. These results show that arousal impacts the early visual activity whereas valence processing would take place later in frontal areas. In conclusion, this study revealed new spatio-temporal dynamics subtending emotional processing.

E71

EMOTION, EMOTION REGULATION, AND CEREBELLAR VERMIS VOLUME Nicole Giuliani[1], Ellora Israni[1], Emily Drabant[1], James Gross[1]; [1]Stanford University — The vermis of the cerebellum is known to play a role in affective experience (Damasio, et al., 2000). Vermis volume is reduced in individuals with major depression (Beyer, et al., 2002), and damage to the vermis has been associated with altered affect (Dolan, 1998). However, it is not yet known how variation in the volume of the vermis relates to emotion and emotion regulation among healthy individuals. In order to investigate this question, we recruited 52 healthy women to undergo high-resolution MRI scanning and complete personality measures. Vermis volumes were calculated using manual Region of Interest methods. Raw volumes were converted to the ratio of vermis volume to total gray matter volume to control for brain size. Participants completed questionnaires assessing their positive and negative affect (Positive and Negative Affect Scale), depression (Beck Depression Index), anxiety (Mood and Anxiety Symptom Questionnaire), and coping styles (COPE Questionnaire). We hypothesized that individuals with smaller vermis volumes would experience more negative emotions and show less emotion regulation as compared to individuals with larger vermis volumes. Preliminary results show that vermis volume is positively correlated with self-reported negative affect ($r = 0.29$, $p = 0.03$) and marginally associated with number of anxious symptoms ($r = 0.27$, $p = 0.07$). It is negatively correlated with coping via denial ($r = -0.30$, $p = 0.03$) and positive reinterpretation ($r = -0.30$, $p = 0.03$). These findings indicate that greater vermis volume is associated with greater negative emotion and lesser emotion regulation.

E72

SUPPRESSING SENSORIMOTOR ACTIVITY MODULATES THE DISCRIMINATION OF AUDITORY EMOTIONS BUT NOT SPEAKER IDENTITY Michael Banissy[1], Disa Sauter[1,2], Jamie Ward[3], Jane Warren[4], Vincent Walsh[1], Sophie Scott[1]; [1]University College London, [2]Max Planck Institute for Psycholinguistics, [3]University of Sussex, [4]Imperial College London — Our ability to recognise the emotions of others is a crucial feature of human social cognition. Functional neuroimaging studies indicate that activity in sensorimotor cortices is evoked during the perception of emotion. In the visual domain, right sensorimotor cortex activity has been shown to be critical for facial emotion recognition. However, the importance of sensorimotor representations in modalities outside of vision remains unknown. Here we used continuous theta-burst transcranial magnetic stimulation (cTBS) to investigate whether neural activity in the right sensorimotor cortices is involved in non-verbal auditory emotion recognition. Two groups of participants completed same-different tasks on auditory stimuli, discriminating between either the emotion expressed or the speakers' identities, prior to and following cTBS targeted at the right premotor cortex or the vertex (control site). A task-selective deficit in auditory emotion discrimination was observed. Stimulation to the premotor cortex resulted in a disruption of participants' abilities to discriminate emotion, but not identity, from vocal signals. These findings indicate that sensorimotor resources are not specifically required for discriminating the identity of others and appear to play a specific role in facilitating emotion discrimination across modalities.

E73

THE NEURAL CORRELATES OF FELT MUSICAL EMOTIONS ACCORDING TO THE GENEVA EMOTIONAL MUSIC SCALE (GEMS) Wiebke J. Trost[1,2,3], Marcel Zentner[4], Patrik Vuilleumier[1,2,3]; [1]University Medical School, University of Geneva, Switzerland, [2]Center for Neuroscience, University of Geneva, [3]Swiss Center for Affective Sciences, University of Geneva, [4]University of York, United Kingdom — Our study explored the neural coding of music-induced emotions with functional magnetic resonance imaging (fMRI), by investigating more refined categories than the simple pleasant/unpleasant or happy/sad differentiations used in previous studies. We based our study on a recent psychological model [1] that proposed nine distinct emotion categories (joy, nostalgia, peacefulness, power, sadness, tenderness, tension, transcendence, wonder) specifically inducible by music. In a blocked fMRI design, participants listened to excerpts of classical music and evaluated their emotions according to the 9-emotion category model immediately after each stimulus. Using statistical parametrical mapping (SPM), we performed a parametric analysis to identify patterns of brain activity that correlated with subjective evaluations for each category separately. Specificities and communalities between categories were defined by a second-level ANOVA. A factor analysis of the nine-dimensional evaluations suggested that two main factors were sufficient to describe the data, which could be interpreted as 'arousal' and 'valence'. Categories representing high arousal (tension, power, joy, wonder) showed activations in superior temporal gyrus and striatum, whereas categories with low arousal (tenderness, transcendence, peacefulness, nostalgia, sadness) were characterized by activations in ventromedial prefrontal cortex and hippocampal regions. For categories with positive valence, we found activations in ventral striatum, ventral tegmentum area, and insula (wonder, joy), while categories with negative valence induced activations in the precuneus. However, in addition to the 2-dimensional arousal/valence differentiations, we could distinguish more specific areas of activation for some categories, including activation in dorso-medial prefrontal cortex for sadness. [1] Zentner et al., Emotion, 2008, Vol.8(4).

E74

GRABBING FOR CASH! REINFORCEMENT VALUE MODULATES REACH-TO-GRASP David Painter[1], Ada Kritikos[1], Jane Raymond[2]; [1]University of Queensland, [2]University of Wales, Bangor — Humans and animals use reward value to maximise desired and minimise undesired outcomes. Consequently, much research has sought to illuminate how rewards and punishers direct behaviour. A key approach has been to assess the effects of reward value on motor behaviour. Humans primarily interact with rewarding objects by reaching and grasping them. The aim of the current study was thus to investigate the effects of reward value on reach-to-grasp. In two experiments, participants learned the monetary values associated with reach-to-grasp targets. Using motion capture and response times, in Experiment 1, we investigated the influence of reward value in an ongoing reinforcement context. Participants reached and grasped one of a pair of champagne flutes. LEDs were placed on the glasses, and the pattern of illumination was informative as to the probability of reward associated with reaching for either flute. Participants won or lost money depending on their selection. In Experiment 2, we examined whether value representation is sufficient to influence motor programming. Here, participants indirectly learned target object values predicted by target colour. Again using motion capture and response times, we measured subsequent reach-to-grasp reaches. We hypothesised that reach-to-grasp would be faster and less variable for more rewarding compared with less rewarding targets. Results from both experiments supported these predictions. Importantly, the results indicate that value representation is sufficient to influence motor programming and that reward value influences reach-to-grasp in a context-dependent manner.

E75

MODULATIONS OF HUMAN EXTRASTRIATE VISUAL NEURONAL ACTIVITY BY EMOTIONAL VOICES: HUMAN INTRACRANIAL RECORDINGS Didier Grandjean[1,2], Julie Péron[1,2,3], Valérie Milesi[1,2], Lucas Tamarit[2]; [1]Neuropsychology of Emotion and Affective Dynamics Laboratory, University of Geneva, Switzerland, [2]Swiss Center for Affective Sciences, University of Geneva, Switzerland, [3]URU 425 Behavior and Basal Ganglia, Movement Disorders Unit, CHU de Rennes, France — The central nervous system has developed specialized neural systems to process relevant information, including emotional prosody in the auditory domain. Several behavioural and EEG studies have shown that visual processing is modulated by emotional prosody processing (Brosch et al, 2008; Brosch et al., 2009). However the neuronal mechanisms underlying these visual modulations through emotional auditory information processing are still unclear. Intracranial local field potentials (LFP) were recorded in the extrastriate visual cortex in a patient prior to surgery for pharmaco-resistant epilepsy while he was instructed to listen to fearful, angry, sad or happy tone of voice, and matched control auditory stimuli. These LFPs were analyzed in the time-frequency domain using Continuous Wavelet Transform. Our results demonstrate that the extrastriate visual cortical activity in the alpha band is differentially modulated by different kinds of emotional prosody. Fearful and anger prosody induced a decrease of alpha activity within the extrastriate visual cortex while the activity related to sad and happy prosody were not different from neutral or matched control stimuli. These results are in line with the view of an early modulation of different sensory human brain areas in response to threatening emotional stimuli and an early influence of the auditory modality on the neuronal activity within the occipital visual cortex.

E76

THREAT RESPONSE AND HYPERAROUSAL ASSESSED IN VETERANS WITH GULF WAR SYNDROME: AN FMRI STUDY Virginia Isabel Buhl[1], Clifford S. Calley[1], John Hart[1], Gail Tillman[1], Timothy Green[1], Jack W. Grinnan[1], Michael A. Kraut[2]; [1]University of Texas at Dallas, [2]Johns Hopkins University — Increased threat response and hyperarousal have been reported among veterans suffering with Gulf War related Illness. We assessed threat response and hyperarousal in the three GW Illness (GWI) subtypes, each shown to have varying degrees of emotional complaints, as well as a veteran control group using a real-not-real discrimination task during fMRI acquisition. Stimuli from the IAPS were used and supplemented with additional pictures of Gulf War combat scenes. Each picture was then modified to create a corresponding meaningless visual stimulus by randomizing the phase information and recombining it with the original picture's magnitude information. Results showed significant increases in signal change for threatening vs. nonthreatening stimuli in GWI groups complaining of heightened threat response compared to controls in areas involved in threat processing, namely occipital and orbital frontal cortex. We hypothesize the significant differences were the result of dysfunction associated with threat processing and arousal.

E77

SHYNESS AND THE FIRST 100 MILLISECONDS OF EMOTIONAL FACE PROCESSING Michelle Jetha[1,2], Xin Zheng[1], Louis A. Schmidt[2], Sidney J. Segalowitz[1]; [1]Brock University, [2]McMaster University — People high in shyness show heightened fear and reduced face and eye contact during social encounters, suggesting differences related to initial face processing. In the current study, we used event-related potentials (ERPs) to examine how the temperament of shyness would affect the early visual processing of emotional faces. Forty-one participants varying in shyness passively viewed either neutral, happy, fearful, or angry faces that were presented serially in a random order. After dividing participants into three groups based on their shyness, the interacting effects between shyness and the type of emotional face stimuli were found in both P1 latency and P1 amplitude. Specifically, for the low-shy group, the P1 latency was shorter for happy faces than for non-happy faces ($p<.001$); for the high-shy group, the P1 latency were shorter for fearful faces than for non-fearful faces ($p = .052$). For the P1 amplitude, the low-shy group showed greater P1 responses to happy than to neutral faces ($p=.002$); in contrast, the high-shy group showed greater P1 responses to fearful than to neutral faces ($p<.001$). The medium-shy group did not differ in either P1 latency or amplitude across face stimuli. For the N170 component, however, neither amplitude nor latency showed a shyness by emotion interaction. Our findings are the first to show that social affiliation styles are related to very early ERP visual processing of emotional faces, which are likely influenced by the amygdala's fast transmission of low-spatial frequency information.

Executive Processes: Monitoring & Inhibitory Control

E78

EFFECT OF DOPAMINE TRANSPORTER GENOTYPE ON METHYLPHENIDATE-INDUCED CHANGES IN FUNCTIONAL CONNECTIVITY DURING RESPONSE INHIBITION IN CHILDHOOD ADHD Eric Murphy[1], Devon Shook[1], William Parrott[1], Jennifer Foss-Feig[1], Laura Kenealy[2], Edwin Cook[3], Mark Stein[3], Chandan Vaidya[1,2]; [1]Georgetown University, [2]Children's National Medical Center, [3]University of Illinois at Chicago — Pharmacological studies have reported that there is considerable variability in the efficacy of methylphenidate in children with Attention Deficit Hyperactivity Disorder (ADHD). This variability may relate to the polymorphism of the dopamine transporter genotype (DAT1) as methylphenidate (MPH) enhances synaptic dopamine by blocking reuptake by the dopamine transporter. We used functional magnetic resonance imaging (fMRI) to examine whether DAT1 modulates MPH-induced changes in connectivity within the neural network underlying response inhibition, a function that is impaired in ADHD. fMRI was performed during a Go-NoGo task on ADHD children, once on and once off MPH, who were heterozygous (9/10) or homozygous (10/10) for the 10-repeat-allele. No significant behavioral differences (measured by NoGo errors) were seen between genotypes. Psycho-physiological interaction analysis was performed on fMRI contrast maps of NoGo > Go conditions to create functional connectivity maps of striatal connectivity. A DAT1 X MPH interaction was observed such that in 9/10 children, striatal connectivity with right dorsolateral prefrontal cortex and left inferior parietal cortex decreased with MPH, whereas in 10/10 children, striatal connectivity these regions increased with MPH. Thus, MPH induced opposite changes in functional striato-cortical connectivity depending upon dopamine transporter genotype during response inhibition in children with ADHD.

Executive Processes: Working Memory

E79

WORKING MEMORY CAPACITY AND NEURAL MECHANISMS OF ATTENTIONAL CONTROL Kate Yurgil[1], Edward Golob[1]; [1]Tulane University — Working memory capacity (WMC) estimates the ability to maintain and manipulate information in working memory and is associated with individual differences in attentional control. Behavioral studies suggest that high WMC conveys greater resistance to distraction. We used event-related potentials (ERP) to test whether high WMC is associated with reduced distractibility, particularly under low perceptual load. Sensory (N100, P200) and attention-related (P3a, P3b, slow wave) ERPs were compared in high (n=13) and low (n=11) WMC groups. Subjects discriminated pure tone targets (1000 Hz) from nontargets at midline. Perceptual load was manipulated using nontarget frequency (low load=500 Hz, high load=950 Hz). White noise distracters were presented at midline or ±90?. Reaction times were faster for low vs. high load ($p<.001$) across WMC groups. The N100 was larger to targets vs. nontargets ($p<.001$), particularly for high WMC ($p<.02$). N100 to distracters was larger for low vs. high WMC ($p<.001$). Amplitude of a negative slow wave to nontargets (~200-400 ms) increased from low to high load ($p<.001$), with larger increases for high WMC ($p<.01$). Overall load effects (low>high) were evident for amplitudes of the N100 ($p<.001$), distracter P3a ($p<.03$), and target P3b ($p<.001$). The P3b also had shorter latencies at low vs. high load ($p<.01$). The ERP results suggest individual differences in WMC are related to early automatic and controlled attentional processing (N100, slow wave) but not attentional orienting (P3a) or later stimulus classification (P3b).

E80

THE NEUROPHYSIOLOGICAL TRACK OF ACOUSTIC SHORT-TERM MEMORY Christine Lefebvre[1], François Vachon[2], Stephan Grimault[1], Synthia Guimond[1], Robert J. Zatorre[3,4], Isabelle Peretz[1], Pierre Jolicoeur[1]; [1]Université de Montréal, [2]Université Laval, [3]Montreal Neurological Institute, [4]McGill University — We sought to uncover neurophysiological activity related specifically to the maintenance of acoustic stimuli in short-term memory (STM) using the event-related potential (ERP) technique. The electro-encephalogram (EEG) was recorded while participants performed a same /different task on two non-musical tone sequences separated by a 2-sec retention interval. Memory load was manipulated parametrically by varying the number of tones in a sequence. The 2, 4, or 6 tones were preceded by white noise fillers to equal sequence length across trials. The voltages measured during the retention interval of this STM task were compared to those measured during completion of a control task. In this control task, participants ignored the first sequence and completed a judgement task on the second sequence. We observed an increase in negativity with memory load at frontal sites in the Memory task, but not in the Control task. We also found a correlation between memory capacity and voltage differences between the load conditions. These findings suggest that not only can we isolate electrical brain activity specifically related to the retention of pitch information in acoustic STM, but we can also link behavioural and electrophysiological data to explain individual differences.

E81

TRANSCRANIAL DIRECT CURRENT STIMULATION TO RIGHT INFERIOR PARIETAL AFFECTS WORKING MEMORY RECOGNITION BUT NOT RECALL Marian Berryhill[1,2], Elaine Wencil[2], H. Branch Coslett[2], Ingrid Olson[1,2]; [1]Temple University, [2]University of Pennsylvania — Converging evidence from neuroimaging and neuropsychology identify the functional involvement of the parietal lobe in working memory (WM). However, the mechanistic role of this region in WM is poorly understood. Recently we have reported that patients with unilateral right parietal lesions were generally impaired at WM across a wide range of stimuli when tested by recognition. In contrast, patients performed normally when tested by recall. We suggest that this dissociation reflects the fact that participants adopt different strategies for storing information under recall and recognition retrieval demands. The recognition strategy is somewhat passive, relying on parietal mediated attention system to store information for short durations, whereas the recall strategy is more active, relying on a subvocal rehearsal mechanism outside parietal cortex. Here, we sought converging evidence for this recall/recognition dissociation using a neural stimulation technique: transcranial direct current stimulation. Participants performed a visual WM task in which 6 pictures of common objects were presented sequentially and followed by a brief (1 s) delay. In separate trial blocks, WM was tested using recognition or recall. Cathodal stimulation (1.5 mA) was applied to the right inferior parietal lobule for ten minutes prior to task performance. Baseline performance was established prior to tDCS. The results replicated and extended our lesion findings: tDCS did not affect performance on recall trials, but did affect performance on recognition trials. These findings are consistent with an attentional account of parietal involvement in WM.

E82

WORKING MEMORY AND FEATURE-BASED ATTENTION SIMULTANEOUSLY MODULATE THE PERCEPTION OF COHERENT MOTION IN HUMAN OBSERVERS Diego Mendoza[1], Megan Schneiderman[1], Julio Martinez-Trujillo[1]; [1]McGill University — Attending to a visual feature selectively modulates the perception of this feature. We investigated whether maintaining the representation of a visual feature in working memory (WM) produces a similar effect, and whether the effects of WM and feature-based attention (FBA) can occur simultaneously. Seven subjects identified the direction of a brief pulse of coherent motion occurring in an otherwise incoherent random dot pattern (RDP). Simultaneously, they performed another task that varied across three experiments: in Experiment 1, subjects attended to four sequential test RDPs to detect motion direction changes. The pulse co-occurred with one of the tests. In Experiments 2 and 3, subjects stored the direction of a sample RDP in WM and subsequently viewed four sequential tests and determined if their directions matched the sample. In Experiment 2, the pulse occurred during an inter-test interval, while subjects held the sample in WM. In Experiment 3, the pulse co-occurred with one of the tests, while subjects maintained the sample in WM and attended to the test. Pulse identification performance was higher when the pulse direction was the same as the concurrently attended test (Experiment 1) or the remembered sample (Experiment 2), than when it was opposite. In Experiment 3, performance was highest when both the remembered sample and the attended test directions were the same as the pulse direction, intermediate when one was the same and the other opposite, and lowest when both were opposite. Our results suggest that WM and FBA can individually or simultaneously modulate motion perception.

E83

INDIVIDUALS WITH CHROMOSOME 22Q11.2 DELETION SYNDROME (22Q11.2DS) EXHIBIT IMPAIRED SPATIOTEMPORAL PROCESSING WHICH IMPACTS SPATIAL WORKING MEMORY PERFORMANCE Ling Wong[1,2], Tracy Riggins[3], Vy Nguyen[2], Margarita Cabaral[2], Leeza Kondos[2], Tony J. Simon[1,2]; [1]University of California, Davis, Neuroscience Graduate Group, [2]M.I.N.D. Institute, Sacramento, CA, [3]University of Maryland — Chromosome 22q deletion syndrome (22q11.2DS) is a mostly spontaneously arising genetic disorder with a prevalence of around 1:400 births that adversely affects cognitive functioning and physiology. Previous research indicates that individuals with the syndrome have relatively intact verbal skills, yet selective impairments in processing of spatial information. This study tested the hypothesis that children with 22q11.2DS exhibit impaired spatial and temporal processing which impact working memory performance, even when controlling for maintenance of attention. METHOD: In a visuospatial working memory task, participants (n=52 22q11.2DS, n=49 typically-developing) aged 7 to 15 years were presented images within a 3x3 grid, and after a delay, participants indicated the positions of the presented images in the correct temporal order. Both the memory load and delay interval were manipulated. ANALYSIS: Trials in which the number of indicated items matched the number of presented items were identified as trials in which attention was successfully maintained. The 22q11.2DS group was subdivided into high and low memory based on a median split of overall performance scores. Analyses examined the effects of diagnosis, memory, and gender. RESULTS: Even when controlling for attentiveness, participants with 22q11.2DS made more spatial and temporal errors than control participants. They had similar sustained attention performance and responses to increasing load. Females made more errors than males, and these were predominantly temporal errors. Results extend the findings of impaired spatiotemporal processing into the memory domain in 22q11.2DS and highlight gender as well as developmental differences in working memory processing.

E84

RELATIONSHIP BETWEEN SPATIAL WORKING MEMORY AND ATTENTION DEFICITS IN MULTIPLE SCLEROSIS Leon Gmeindl[1], Susan M. Courtney[1]; [1]Johns Hopkins University — Multiple sclerosis (MS) is an immune-mediated demyelinating disease that results in widespread white-matter lesions. It is not surprising, therefore, that impairment in working memory (WM), a neurocognitive system that relies on communication among distant regions, is common in MS. While most research on WM abilities in MS has focused on verbal information, recent work in our laboratory revealed MS-related impairment on computerized variations of Spatial Span, a task that requires encoding, maintenance, and reproduction of sequences of locations. There was no differential MS-related effect on performance of increased delay length, however, indicating that maintenance (rehearsal) of spatial information was not impaired. In the current study, we targeted other component WM processes. In Experiment 1, in addition to the serial recall (span) test, a serial recognition test was given that eliminated the need for uncued retrieval and manual reproduction of spatial sequences: subjects simply indicated whether sample and test sequences matched by pressing one of two response keys. Patients were impaired on both tests, indicating that poor performance on the serial recall test was not necessarily due to a deficit in the uncued retrieval of spatial information nor to degraded motor processing. In Experiment 2, results from a version of the Posner cueing paradigm indicate inefficient voluntary orienting of attention to relevant locations in MS, a deficit that likely results in impoverished encoding of spatial information into WM. Rapid, voluntary orienting of attention may be more vulnerable to the effects of white-matter lesions than is spatial WM maintenance.

E85

EVIDENCE OF INDIVIDUAL DIFFERENCES IN WORKING MEMORY CAPACITY USING EVENT-RELATED POTENTIALS: INFLUENCE OF DISTRACTORS ON VISUAL WORKING MEMORY A. Becke[1], H. Strumpf[2], J-M. Hopf[1,2], N. Müller[1]; [1]Otto-von-Guericke-University Magdeburg, Germany, [2]Leibniz-Institute for Neurobiology Magdeburg, Germany — A study by Vogel and colleagues (2005) revealed a strong correlation between an individual´s Working Memory Capacity (WMC) and the ability to filter out task-irrelevant information, indexed by EEG contralateral delay activity (CDA). In this framework, we assessed the role of distractor information for the processes of encoding and retrieval in visual WM as a function of WMC. EEG data were recorded in 38 subjects, of whom 18 scored low in an independent visual WMC assessment scale. In the S1-S2 change-detection task the orientation for only the target colored items, in the left or right visual field (indicated by an arrow before each of the trials), should be remembered. Distractors were induced in form of two different-colored items (S1) and due to changes in the orientation of an item in the unattended side in the visual field (S2). Subjects with a low WMC where much more affected while encoding information, as revealed by the raised CDA. Furthermore low WMC subjects showed significantly higher failure rates due to distractors in the retrieval phase (S2). Parietal and occipital brain regions, show increased activity for periods of processing distractor information. The results elucidate the mechanisms of distractor processing as a function of WMC and highlight two underlying effects of an early filter deficit and the inefficient suppression of distracters in the retrieval phase of visual WM.

E86

PROBING THE FUNCTION OF DELAY-PERIOD ALPHA-BAND OSCILLATIONS IN VISUAL WORKING MEMORY David Sutterer[1], Jeffrey Johnson[1], Daniel Acheson[1], Bradley R. Postle[1]; [1]University of Wisconsin-Madison — Sustained alpha-band power has been reliably observed during the delay period of working memory tests. Although alpha-band oscillations in working memory have been variously attributed to processes such as, idling, active suppression, and coordination of cross-frequency phase dynamics, their role remains unclear. The present study systematically investigated sustained alpha-band activity during spatial delayed recognition through manipulations of stimulus identity and behavioral context. Subjects completed five variants of visual delayed recognition while 60-channel EEG was recorded. In the first condition, to-be-remembered locations were cued with uniform circles. In the second condition, locations were cued with randomly selected difficult-to-name Attneave shapes, although subjects were explicitly instructed to ignore the variation in shape. The third and fourth conditions featured the same stimulus presentation, but pre-trial instructions specified whether subjects should remember locations or object identities. Finally, the fifth condition required memory for objects in locations. Results showed relative increases in alpha-band spectral power (8-14 Hz) as object identity increased in salience. For location memory trials, delay-period alpha-band power was greater in the second condition (when stimuli were irrelevant Attneave shapes) than the first (no stimulus shape variation), and greater still when location memory trials were randomly interleaved with object memory trials (i.e., in a behavioral context when object identity was periodically relevant to behavior). These results provide support for the idea that one function of sustained delay-period alpha-band oscillations is the active suppression of trial-irrelevant information.

E87

THE SNAP25 GENE IS LINKED TO WORKING MEMORY CAPACITY AND MATURATION OF THE POSTERIOR CINGULATE CORTEX DURING CHILDHOOD Stina Söderqvist[1,2], Fiona McNab[1,2], Myriam Peyrard-Janvid[1], Hans Matsson[1], Keith Humphreys[1], Juha Kere[1,3], Torkel Klingberg[1,2]; [1]Karolinska Institutet, [2]Stockholm Brain Institute, [3]University of Helsinki — Working memory is the ability to retain task relevant information. This ability is closely related to attention and is important for a wide range of cognitive tasks. Deficits in working memory are a central cognitive impairment in neurodevelopmental disorders such as attention-deficit/hyperactivity disorder. Although working memory capacity is known to be highly heritable, the majority of genes involved remain unidentified. Here we show that working memory capacity is related to a common polymorphism (rs363039) in the gene coding for synaptosomal-associated protein, 25kDa (SNAP25), in a normal population of children and adolescents. We used magnetic resonance imaging techniques to demonstrate that this polymorphism affects the maturation of grey matter as well as brain activation in the posterior cingulate cortex, regions previously implicated in regulation of attention. We thus identified a gene-brain-behavior network which could be a key for understanding cognitive development as well as some of its disorders.

E88

INVESTIGATING PREFRONTAL CONTRIBUTIONS TO WORKING MEMORY DEFICITS IN TURNER SYNDROME Signe Bray[1], Bria Dunkin[1], David Hong[1], Allan Reiss[1]; [1]Stanford University — Turner syndrome (TS), a genetic disorder characterized by complete or partial absence of an X chromosome in females, has been consistently linked with deficits in visuospatial skills and executive function, but relatively intact language skills. In this study we investigated brain networks subserving working memory (WM) in both visuospatial and phonological domains, hypothesizing that visuospatial WM would be more impaired than phonological in TS, and that this interaction would be reflected in brain activity. We used functional magnetic resonance imaging (fMRI) to scan both typically developing (TD) and TS participants (all females, aged 7-14), while they performed visuospatial and phonological 1-back and 2-back memory tasks. Accuracy measures indicated that the phonological task was more difficult, and TS participants were overall less accurate, but there was no interaction between diagnosis and task or memory-load. We found that across groups and modalities, a network of regions was increasingly active for greater memory-load, including bilateral dorsolateral prefrontal cortex (DLPFC), anterior insula, and parietal regions. Among these areas, only the left DLPFC was more engaged by memory-load in the TD group relative to TS. We also found a significant modality by diagnosis interaction in the right DLPFC, which was more active for phonological relative to visuospatial in TD, but not TS. Taken together, these findings complement prior work showing that DLPFC plays an important role in WM performance in TS, and contribute novel findings by showing that this effect is not specific to visuospatial tasks.

E89

ESTROGEN MODULATION OF FRONTAL LOBE CIRCUITRY DURING VERBAL WORKING MEMORY IN OLDER WOMEN Julie Dumas[1], Amanda Kutz[1], Christy Edgren[1], Ashley Pfaff[1], Paul Newhouse[1]; [1]University of Vermont College of Medicine — Prior research shows that hormonal changes after menopause result in changes in cognition in some older women. However, little is known about how estrogen loss and subsequent estrogen treatment affects cognition and the underlying brain processes responsible for any cognitive changes. We tested the ability of estrogen to modulate working memory performance and related brain activation in postmenopausal women. Twenty healthy postmenopausal women were assigned to three months of 1 mg oral 17-? estradiol or placebo. At baseline and three months later each woman completed a visual verbal N-back test of working memory during functional magnetic resonance imaging (fMRI). The fMRI data showed that women who were treated with estradiol for three months had greater bilateral activation in the middle frontal gyrus (Brodmann area 9) compared to women treated with placebo. Performance on the verbal working memory task showed no difference between estradiol and placebo treated subjects. These data are consistent with prior work showing increases in frontal activation on memory tasks after estrogen treatment. However, this is the first study to show frontal increases during verbal working memory specifically. These data suggest that estradiol treatment in postmenopausal women may affect the manipulation component of working memory supported by the frontal lobes necessary for good performance on the N-back task.

E90

DISTRIBUTING THE LOAD: AGE-RELATED DIFFERENCES IN THE EXTENT OF LOAD-DEPENDENT NEURAL ACTIVITY IN VISUAL SHORT-TERM MEMORY Carson Pun[1], Kristin Wilson[1], Maha Adamo[1], Peter J. Lenkic[2], Susanne Ferber[1]; [1]University of Toronto, [2]University of British Columbia — The ability to hold visual information in mind after it is no longer physically present seems to decline with age. The amount of information held in visual short-term memory (VSTM) is reflected electrophysiologically in a negative ERP waveform known as the contralateral delay activity (CDA), which is computed as the difference between contralateral and ipsilateral activity and whose amplitude correlates with VSTM capacity. Using EEG, we employed a VSTM change-detection task where participants' attention was directed to one side of a bilateral display and they were asked to remember various numbers of colored squares presented together for 100 ms. Following a brief delay, participants saw a single probe square and were asked to indicate whether the color of the probe was the same as the item appearing in that location during the memory array. We observed a significant CDA across multiple posterior sites for both young and older adults. In both groups, the amplitude of the CDA was load-dependent; however, the extent of the load-dependent negativity was more widespread for young adults and restricted to only the topographical peak of the CDA for older adults. That is, load-dependent increases in CDA amplitude were more focal in older adults. This load-dependent difference between the two age groups did not only affect the initial uploading of items into VSTM but also subsequently affected the degree to which the CDA was sustained. Thus, changes in the efficacy of the posterior VSTM system contribute to the observed decline in VSTM capacity for older adults.

E91

UNDER ADDITIVITY OF INSTRUCTION AND REPORTED ITEMS IN WORKING MEMORY Katia Gagnon[1], André Achim[1]; [1]Université du Québec à Montéal — Working memory (WM) is a capacity-limited cognitive system that maintains task relevant information readily available in the brain. The present experiment aimed at documenting the extent to which instruction items compete with to-be-reported items in a WM span task. Methods: Ten college students observed sequences of 4 individual symbols (either 4 different letters or 4 non letters: #$%&) constituting the instruction items, followed by 3 to 8 triplets of symbols, after which they had to report one item from each triplet, namely the left or right letter, depending on whether the middle item belonged or not to the instruction set. The non letter instruction set served to control for the potential cost of letter selection on WM span. There were two trials of each type, in random order, for each number of triplets. The subjects proceeded to the next level if they reported all correct items in correct order at least once. The highest level reached with each type of instruction set constituted the dependent variable. Result: The average span levels reached were 4.4 (experimental) and 6.2 (control). This difference of 1.8 differs significantly both from 0 (no experimental effect) and from 4 (expected if each instruction letter occupied one WM capacity unit). Conclusion: The observed under additive effect suggests that Items that must be recognized to perform the task occupy WM differently than items to be reported. In this paradigm, recognition and report may respectively rely on the visuospatial sketchpad and the phonological loop components of the WM system.

E92

ALTERED PREFRONTAL CONNECTIVITY DURING SPATIAL AND OBJECT WORKING MEMORY PERFORMANCE IN MULTIPLE SCLEROSIS Yi-Shin Sheu[1], Caroline Montojo[1], Megan Walsh[1], Susan Courtney[1,3]; [1]Johns Hopkins University, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, Maryland — Background: Multiple Sclerosis (MS) is an immune-mediated demyelinating disease. Working memory (WM) deficits are common, presumably due to disruptions in communication among brain regions. Previous studies found recruitment of additional brain regions in individuals with MS during cognitive tasks. It is thought this recruitment might limit expression of cognitive deficits, but the mechanism is unknown. We hypothesized that anterior prefrontal cortex (aPFC), a region involved in executive function, often activated in both spatial and nonspatial WM, might contribute to this compensatory plasticity through altered interactions with other brain areas. Methods: FMRI data was collected while 15 subjects (24-55 year-old) with relapsing-remitting MS, and 11 age-matched controls performed delayed-recognition tasks involving either locations or identities of three faces. Psychophysiological interaction analysis was used to identify group differences in whole-brain functional connectivity with aPFC specified as the seed region, during each WM task relative to a sensorimotor control task. Results: During spatial WM performance, MS-related reduction in connectivity with aPFC was observed for insular, medial and superior frontal, and lateral parietal regions, and enhancement was observed for middle frontal, occipital and posterior parietal regions. During object WM performance, individuals with MS showed decreased connectivity with thalamus and parietal regions relative to healthy controls, while increased connectivity with occipitotemporal and bilateral parahippocampal regions was observed. Conclusion: Decreases in functional connectivity with aPFC during spatial and object WM performance were observed in MS, suggesting the normal WM pathways were disrupted. In contrast, several other regions show enhanced connectivity with aPFC, perhaps reflecting compensatory reorganization.

E93

FLUCTUATING INSTRUCTIONS DO NOT EASILY INCREASE WORKING MEMORY LOAD André Achim[1], Katia Gagnon[1], Mélanie Demers[1], Caroline Picard[1]; [1]Université du Québec à Montéal — Working memory (WM) is the capacity to hold context relevant information and manipulate it. Maintaining task instructions could involve either WM or regular (long term) episodic memory. But the latter is ill suited to distinguish very similar episodes in close temporal and context proximity, like frequently changing instructions for equivalent stimuli. Thus, frequently changing instructions might create an extra load on WM compared to homogeneous instructions within blocks of trials. This speculation was tested with sequences of 6 alternating visual letters and numbers, to be reported according to one of 6 possible instructions (e.g. "numbers in descending order then letters in alphabetical order) by clicking on letters or digits respectively across the top or bottom of the screen. Nine college volunteers received 12 blocks of 12 trials. The trial sequence intermixed six blocks of randomly mixed instructions (two of each type) and six of uniform instructions, one block per instruction. Contrary to expectation, the success rate in the mixed blocks (78.7% of sequences correctly reported) was not lower than that in the uniform blocks (78.4%). Behavioural observations indicate that, in the mixed blocks, most participants encoded the required report sequence using the screen layout (e.g. start bottom right, end top right), possibly translating it into the visuospatial sketchpad. If mixed blocks taxed a WM component (episodic buffer or visuospatial sketchpad) other than the phonological loop, there was no sign of interference between their respective loads. Instructions might interfere only when they directly tax the involved WM stimulus holding resource.

E94

COGNITIVE CONTROL AND PROACTIVE INTERFERENCE IN WORKING MEMORY IN SCHIZOPHRENIA Teal S. Eich[1], Edward E. Smith[1,2], Deniz Cebenoyan[1], Elena Derkits[2], Chara Malapani[2]; [1]Columbia University, [2]New York State Psychiatric Institute — Deficits of cognitive control (CC), including inhibition in working memory (WM), have been reported in schizophrenia (SCZ). A single cause has been assumed to underlie these effects. In contrast, we hypothesized that there are multiple CC processes, and neural dysfunction in SCZ may result in impairment in only some of these processes. We tested schizophrenics and controls on a task previously shown to dissociate brain mechanisms underlying the ability to ignore distracting perceptual information (occipital cortex) and inhibit information in WM (left lateral PFC). In the "Ignore" condition, subjects saw a cue to remember either the red or blue words, followed by a word-set (2 red, 2 blue), and a memory probe. The "Suppress" condition was identical, except the word-set came before the instruction-cue. Forty-percent of the memory probes were words subjects were supposed to maintain in WM (positives), 30% were words not to be maintained in WM (dropped-negatives), and 30% were words that had not appeared in the word-set (non-familiar negatives). Additionally, the word-pool number (40 or 80 total) was manipulated between-subjects, to test the effects of proactive interference (PI) in SCZ. We found that schizophrenics were selectively impaired only on Suppress dropped-negative-trials in both the 40 and 80-word task. Schizophrenics, but not controls, also showed a PI effect, such that RT was greater in the 40-word task than the 80-word task. These findings suggest that schizophrenics are impaired in suppressing information in WM, and information from previous trials, but intact in inhibiting information prior to entry into WM.

E95

DORSOLATERAL PREFRONTAL CORTEX ACTIVATION RELATED TO PAIN AFTER MILD TRAUMATIC BRAIN INJURY Nadia Gosselin[1,2], Jen-Kai Chen[1,2], Carolina Bottari[1,2], Michael Petrides[1,2], Simon Tinawi[3], Élaine de Guise[2,3], Alain Ptito[1,2]; [1]Montreal Neurological Institute and Hospital, Montreal, Canada, [2]McGill University, Montreal, Canada, [3]Montreal General Hospital, Montreal, Canada — Introduction: We recently showed a reduction in the dorsolateral prefrontal cortex (DLPFC) activity using functional magnetic resonance imaging (fMRI) in subjects with mild traumatic brain injury (MTBI) (Chen et al, 2004) during performance of the visual externally ordered task, a working memory task devised by Petrides (2000). To date, no studies have investigated the effects of pain on cerebral functioning in MTBI subjects, although chronic pain associated to headaches are reported by more than 50% of this population. The aim of the study was to measure the relationship between pain and activation in the DLPFC during the working memory task in MTBI subjects. Methods: Nineteen subjects (11 women; age: 28.6±11.3 years; 8.5±8.5 months post-injury) were tested with fMRI and were compared to 26 controls (14 women; age: 28.5±9.3 years). They performed the visual externally ordered task and a baseline control task. Pain attributed to headaches at the moment of the testing was evaluated using a visual analogue scale. Results: No group differences were found for either reaction time or accuracy. MTBI subject reported more pain than controls ($p<0.001$). In fMRI, lower activations in the right ($p<0.01$) and left DLPFC ($p<0.05$) were found in MTBI compared to control subjects. A significant correlation was found between pain and activation in the right DLPFC ($r=-0.59$, $p<0.01$) where MTBI subjects with higher pain had lower activation. Conclusion: Our results confirm that MTBI can produce functional consequences that can be associated to the presence of pain.

E96

STRIATAL LEARNING FOLLOWING ACUTE SOCIAL STRESS IN A CIGARETTE WITHDRAWN STATE Clio Pitula[1], Tal Ben-Simhon[1], Alain Dagher[1], Michael J. Frank[2], Lesley K. Fellows[1]; [1]McGill University, [2]University of Arizona — Changes in ventral striatum dopamine are believed to influence the gradual transition from casual to uncontrolled drug use. Stress is a known trigger for relapse in addicted smokers and can stimulate dopamine release. Brain imaging studies have found a link between psychological vulnerability and increased striatal dopamine in response to social stress. Reinforcement learning tasks can serve as an indirect probe of striatal dopamine function. In an earlier study, we found differences between smokers and tobacco 'chippers', long term casual smokers, during ad libitum smoking but not during withdrawal on one such task. The present study investigates whether social stress, through its known effects on dopamine, affects task performance in the same populations. We used validated dependence questionnaires to classify participants as addicted smokers (N=29) or chippers (N=23); groups were matched on demographic variables. Following 18 hours of cigarette abstinence, participants performed two versions of the GoNogo learning task, separated by either a social stress manipulation (TSST) or a non-stress control task. Replicating our earlier results, there were no learning differences at baseline. The stress manipulation, despite leading to subjective reports of increased stress in all participants, did not affect task performance, either between or across groups. Moreover, while smokers differed from chippers in their subjective reactions to withdrawal, they reported similar levels of stress in response to the manipulation. Thus, acute social stress does not substantially affect dopamine-mediated learning in either addicted or casual smokers in withdrawal, arguing against a role for dopamine in stress-induced relapse.

E97

NEURAL CORRELATES OF SHORT VERSUS LONG DURATION TIMING: AN FMRI STUDY IN ADOLESCENTS James Porter[1], Paul Collins[1], Ryan Muetzel[1], Monica Luciana[1]; [1]University of Minnesota — We investigated brain regions involved in the perception and reproduction of discrete time intervals. Prior studies indicate that interval timing involves a distributed cortical-subcortical circuit. Regions including the caudate, the insula, the putamen, the supplementary motor area (SMA), the pre-SMA, ventrolateral prefrontal cortex (VLPFC), and medial parietal cortex have been implicated in interval encoding. Interval reproduction has been associated with dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex (ACC), fusiform cortex, the putamen, and parahippocampal cortex. Additionally, these regions may be differentially involved for short (less than 3 seconds) versus long (3+ seconds) intervals, with the shorter duration timings primarily recruiting SMA and pre-SMA. However, the extent to which these dissociations apply to the four cross-combinations of short/long and encoding/reproduction parameters is unclear. In order to investigate this, 30 healthy subjects were asked to perform an interval timing task during fMRI scanning. The task included short (1000-2500ms) and long (5000-6500ms) trials that required encoding and reproduction of the time intervals. Short trials recruited SMA and motor cortex to a greater extent during the encoding phase than did long trials. Longer trials required greater activation of pons, thalamus, and ACC during encoding. Overall, reproduction engaged pre-SMA, hippocampal/parahippocampal areas, thalamus, putamen, pallidum, and caudate. Short reproductions additionally recruited bilateral DLPFC and VLPFC, ACC, and insula. The results indicate that short-interval encoding is carried out in pre-motor regions, while longer encoding requires more extensive cortical-subcortical activations. In contrast, reproducing shorter intervals requires greater prefrontal cognitive control areas than does long-interval reproduction.

E98

SHORT-TERM MEMORY: DISTINGUISHING THE REGION OF DIRECT ACCESS FROM THE ACTIVATED PORTION OF LONG-TERM MEMORY Derek Nee[1], John Jonides[2]; [1]Indiana University, [2]University of Michigan — Several competing psychological models have been put forth hypothesizing different architectures of short-term memory. Recent work has established that within short-term memory, a single item can be distinguished within the focus of attention that demonstrates privileged access and a unique neural signature. Whether memory outside of the focus of attention can be further sub-divided remains an open question. One account posits that outside of the focus of attention, a limited set of items resides in a region of direct access (RoDA) with other items in mind comprising the activated portion of long-term memory (LTM). A competing account contests that all memory outside of the focus of attention is of one sort. Here, we use a serial item-recognition task and fMRI to test these models. Behavioral performance demonstrated a sharp drop-off for items putatively in LTM compared to the RoDA. Neurally, the left prefrontal cortex (PFC) demonstrated heightened activation for items in LTM compared to the RoDA. Surprisingly, the hippocampus demonstrated the opposite pattern: items in the RoDA were more active compared to items in LTM. Activation in both regions correlated with behavioral data and estimated working memory capacity. Finally, psycho-physiological interaction (PPI) analysis revealed functional interactions between the hippocampus and phonological loop for the RoDA, and between left PFC and the ventral stream for LTM. These results suggest that distinct memory codes form the basis of the RoDA and LTM, and support models that posit a tripartite memory architecture.

E99

CONTRIBUTION OF POSTERIOR PARIETAL CORTEX PERSISTENT ACTIVITY TO VISUOSPATIAL WORKING MEMORY Kevin Johnston[1], Emiliano Brunamonti[1], Neil Thomas[1], Martin Pare[1]; [1]Queen's University — Parietal cortical areas have been implicated as a critical link in the network of brain areas underlying working memory. One line of evidence supporting this has been provided by neural recordings in primates performing the memory-guided saccade task. Neurons in parietal cortex, including the lateral intraparietal area (LIP), have been shown to exhibit persistent activity during the memory delay of this task. Such activity has been considered a neural signature of working memory, but the contribution of LIP persistent activity to mnemonic processes remains poorly understood. Specifically, it is unclear whether persistent activity represents a retrospective visual or prospective saccade-related code. To investigate this, we recorded the activity of single LIP neurons in three monkeys while they performed memory and visually-guided saccade tasks, and carried out two sets of analyses. We first compared the visual and motor responses of each neuron with persistent delay activity during memory-guided saccades. LIP neurons exhibited a pattern of activity consistent with retrospective coding: most neurons had greater visual than saccade-related activity, and persistent activity was most strongly linked with the preferred direction of each neuron. To evaluate the fidelity of this visual signal, we compared measures of discharge rates and variability between visual and memory delays. Activity of LIP neurons was lower, and variability of responses higher, during memory delays. These data show that LIP persistent activity is retrospectively biased, but of low fidelity, and suggest a neural basis for the capacity limit of visual working memory.

E100

ERP EXPLORATIONS OF THE RELATIONSHIP BETWEEN FILTERING IRRELEVANT INFORMATION AND WORKING MEMORY CAPACITY Maria Kharitonova[1], Tim Curran[1], Yuko Munakata[1]; [1]University of Colorado at Boulder — A number of studies report that high working memory (WM) capacity leads to better filtering of task-irrelevant information (e.g. Vogel et al., 2005), suggesting that better WM enables more efficient allocation of memory resources. However, in situations where filtering could be disadvantageous to subsequent performance, high WM capacity is sometimes associated with a broad attentional focus, resulting in low filtering (e.g. Just & Carpenter, 1992). Thus, high WM capacity might support a dynamic updating of filtering strategy, depending on task demands. We test this possibility by manipulating filtering demands within a single paradigm. In all conditions, participants needed to make same/different judgments for visual arrays that contained either 2 task-relevant objects, 4 task-relevant objects, or 2 task-relevant and 2 irrelevant objects (as in Vogel et al., 2005). In the high filtering demand condition, changes in the irrelevant objects were orthogonal to changes in the relevant objects, thus increasing the need to filter irrelevant objects. In contrast, in the low filtering demand condition, the relevant and irrelevant objects changed consistently, thus minimizing the need for filtering. Behavioral measures of WM capacity and ERP measures of filtering were calculated as in Vogel et al. (2005). Results show more filtering in the high filtering demand condition than in the low filtering demand condition. Moreover, as predicted, this effect was modulated by WM capacity, such that a positive relationship between WM and filtering was only observed in the high filtering demands condition, suggesting a dynamic change of filtering strategy, based on task demands.

E101

BRAIN ACTIVITIES RELATED TO WORKING MEMORY UPDATING FOR SPATIAL AND OBJECT INFORMATION: AN ERP STUDY Satoshi Abe[1], Keiichi Onoda, Shuhei Yamaguchi; [1]Shimane University — The working memory (WM) update is understood as a type of switching between the activity for maintaining the current string of items and the activity for changing this list. Converging evidence indicates that dorsolateral prefrontal cortex is involved in this executive process. In this study we recorded ERPs during a WM task and compared brain activities related to memory updating for spatial and object information. We also analyzed the effect of task load. Seventeen healthy participants performed n-back tasks, where single alphabet was sequentially presented randomly one at a time in one of the nine squares arranged 3×3. The participants recalled the alphabet presented n trials previously for the object WM task, the place of the alphabet presentation n trials previously was recalled for the space WM task. In 3-back task (low load), we defined the first three trials as control trials. After the forth (update trials), they need to update of information to maintain recent three items. In 4-back task (high load), the first four were the control, after the fifth were the update. Correct response rates were 87.9% for the 3-back and 72.8% for the 4-back object task, whereas 93.9% for the 3-back, 86.4% for the 4-back space task. There was main effect of update at P3 component in frontal and parietal region, but no main effect for task load and stimulus type. This study suggests that WM update processing occurs at P3 component, and the neural processing might not be modulated by task load and stimulus type.

E102

PRE-FRONTAL CORTEX DYSFUNCTION IN GULF WAR ILLNESS G. Andrew J. Hillis[1], Traci I. Sandoval[1], Michael A. Motes[1,2], Ilana J. Bennett[1,2], Mary Jo Maciejewski[1,2], Joanna Hutchison[1,2], Bart Rypma[1,2]; [1]Center for BrainHealth & School of Behavioral & Brain Sciences University of Texas at Dallas, [2]University of Texas Southwestern Medical Center — Gulf War Illness (GWI) is an amalgamation of symptoms that might result from neurotoxic exposure. One GWI syndrome group is primarily characterized by cognitive deficits (Impaired Cognition) possibly resulting from neural dysfunction. To test this hypothesis, we assessed neural activity during working memory (WM) performance in this Impaired Cognition group and an age-matched control group. Individuals performed a modified Sternberg WM task in which they were instructed to encode a memory set of 2, 4, or 6 letters, maintain this material over an unfilled delay period, and then judge whether or not a single probe letter was present in a retrieval period. Behavioral results revealed that both groups were faster and more accurate for lower vs. higher set sizes, but there were no significant group differences in these WM load-related effects. Imaging results revealed load-related (set size 2 vs. 6) activity in pre-frontal (PFC) and parietal cortex. The magnitude of these WM load effects differed between patients and controls, with the direction of these effects varying across task periods. Relative to controls the GWI patient group showed decreased PFC and parietal activity at encoding, similar PFC activity but increased parietal activity during maintenance, and increased PFC and parietal activity during retrieval. In sum, this Impaired Cognition GWI group had distinct patterns of WM-related neural changes compared to controls, but these were not associated with significant WM deficits. Such syndrome-specific neural effects may reflect strategy changes that allow participants to optimize WM performance despite reduced brain function from neurotoxic exposure.

E103

TMS-EVOKED RESPONSE VARIES WITH INSTANTANEOUS PHASE IN THE ALPHA BAND Bornali Kundu[1], Daniel J. Acheson[1], Jeffrey S. Johnson[1], Bradley R. Postle[1]; [1]University of Wisconsin, Madison — Variation in the power and phase of oscillations in the alpha frequency band (8-14Hz) predict trial-by-trial variation in a wide range of tasks, including visual perception and visual working memory. The effect of transcranial magnetic stimulation (TMS) on alpha-band power also predicts the effects of TMS on working memory performance, although the precise mechanism underlying these effects is unknown. To explore this, subjects performed a spatial delayed-recognition task while we administered TMS during the delay period. Data were binned according to phase of the alpha-band oscillation at which TMS was delivered, and the relationship between this pre-stimulus phase and power of the resulting evoked response in the theta (4-8Hz), alpha (8-14 Hz), beta (15-25 Hz), and gamma (30-60 Hz) bands was explored. Immediately following the TMS pulse there is a broadband decrease in power followed by a sharp increase at 50ms post-TMS. The TMS-evoked response in the alpha and beta bands was greatest when TMS was delivered at between -90 and 90 degrees of the cycle of the alpha-band oscillation, whereas there was a general decrease in power across all frequency bands when TMS was delivered at between 90-180 degrees of the cycle of the alpha-band oscillation. These results suggest that when TMS hits the brain near the trough of the alpha wave, there is a general suppression of resulting frequencies, whereas when delivered during the rising phase, near the crest of the alpha wave, there is a resulting increase in the subsequent power of alpha and beta bands.

E104

WORKING MEMORY MONITORING OF AIR TRAFFIC CONTROLLERS USING FUNCTIONAL NEAR INFRARED SPECTROSCOPY Hasan Ayaz[1], Scott Bunce[2], Ben Willems[3], Sehchang Hah[3], Patricia Shewokis[1,4], Kurtulus Izzetoglu[1]; [1]School of Biomedical Engineering, Science & Health Systems, Drexel University, [2]Penn State Hershey Neuroscience Institute, Penn State University, [3]Atlantic City International Airport: Federal Aviation Administration William J. Hughes Technical Center, [4]College of Nursing and Health Professions, Drexel University — Significant progress has been made over the last decade in understanding the physiological and neural bases of cognitive processes and behavior. The advent of new and improved brain imaging tools, that allow monitoring brain activity in ecologically valid environments, is expected to allow better identification of neurophysiological markers of human performance. Further, deployment of portable neuroimaging technologies to real time settings could help assess cognitive and motivational states of personnel assigned to perform critical tasks. Functional Near-Infrared Spectroscopy (fNIR) is an emerging optical brain imaging technology that relies on optical techniques to detect changes of hemodynamic responses within the prefrontal cortex in response to sensory, motor, or cognitive activation. Teaming with ongoing studies at the Federal Aviation Administration (FAA) William J. Hughes Technical Center's Research, Development, and Human Factors Laboratory, fNIR has been used to monitor certified controllers as they manage realistic scenarios under typical and emergent conditions. As part of the study, 24 participants performed a standardized n-back task; which is a working memory assessment task with 4 conditions of controlled difficulty level. Repeated measures analysis of variance showed that average oxygenation changes at voxel that is close to AF7 in International 10-20 System, located within left inferior frontal gyrus in the dorsalateral prefrontal cortex, correlates with the task difficulty and increases monotonically with increasing task difficulty ($F= 8.17$, $p<0.01$). Post-hoc analysis showed a linear relationship with task difficulty and oxygenation changes. These results are in agreement with recent meta-analysis of fMRI data of n-back studies.

E105

IS DOPAMINE DIFFERENTIALLY ASSOCIATED WITH COGNITIVE FUNCTIONING IN WOMEN AND MEN? Sari Karlsson[1], Anna Rieckmann[1], Yvonne Brehmer[1], Per Karlsson[1], Lars Farde[1], Lars Nyberg[2], Lars Bäckman[1]; [1]Karolinska Institutet, [2]Umeå University — Several lines of research (animal, molecular imaging, genetic, computational modelling) have demonstrated an association between dopamine (DA) function and cognitive functioning. However, little is known about potential sex differences in the DA-cognition relationship. In this study, we used Positron Emission Tomography (PET) and SCH23390 to quantify D1 receptor binding in healthy younger (10 male and 10 female) participants. A variety of cognitive tests were administered at a separate occasion, but in close proximity to the PET measurement. Results show no significant sex differences in D1 receptor binding potential in striatal (associative, sensorimotor, and limbic), medial temporal (hippocampus and amygdala), or frontal (DLPFC and ACC) brain regions. However, in women D1 binding in most brain regions correlated strongly with perceptual speed and general intelligence, and D1 binding in frontal and medial temporal regions correlated strongly with working memory span, although there were no associations between D1 binding and executive functioning. By contrast, in men there were no correlations between D1 binding and perceptual speed, general intelligence, or working memory span, but a significant association between D1 binding in medial temporal lobe regions and executive functioning. These findings suggest that DA function is differentially related to cognition in men and women.

E106

NEURAL AND BEHAVIORAL EVIDENCE OF WORKING MEMORY DIFFERENCES IN MUSICIANS AND NON-MUSICIANS Elyse George[1,2], Donna Coch[2,3]; [1]Neuroscience Program, Dartmouth College, [2]Reading Brains Lab, [3]Dartmouth College — Previous research has suggested that music training improves working memory. However, it is unclear which domain(s) of working memory might be affected: executive control, auditory working memory (phonological loop), or visual working memory (visuospatial sketchpad). Using event-related potentials (ERPs) and a standardized test of working memory (Test of Memory and Learning, TOMAL-2) with college undergraduates, we investigated both neural and behavioral aspects of working memory in nonmusicians ($n = 16$) and musicians, none of whom were professional musicians ($n =16$). Musicians had 9-16 years of musical training and currently played 3-15 hours per week. Nonmusicians had fewer than 5 years of musical training, prior to age 14. ERPs were recorded in standard auditory and visual oddball paradigms. The latency of the typical P300 to deviants was earlier in musicians than nonmusicians in both the auditory ($p = .01$) and visual ($p = .004$) paradigms. The amplitude of the P300 to deviants was larger in the musicians only in the auditory paradigm ($p = .036$). Behaviorally, musicians outperformed nonmusicians on the TOMAL-2 subtests of visual, phonological, and executive memory. These results suggest that music training is associated with improvements in various aspects of working memory, as reflected by both behavioral and neural measures.

E107

CONVERGING FMRI EVIDENCE FOR A ROLE OF THE LEFT INFERIOR FRONTAL LOBE IN SEMANTIC RETENTION DURING LANGUAGE COMPREHENSION A. Cris Hamilton[1], Philip Burton[2], Randi Martin[1]; [1]Rice University, [2]University of Minnesota — An increasing amount of evidence supports dissociable semantic and phonological short-term memory (STM) capacities. Patient data suggest that the left inferior and middle frontal gyri are associated with semantic STM deficits, while damage to inferior parietal areas is associated with deficits of phonological STM. In addition, semantic and phonological STM deficits have different consequences for language production and comprehension, with patients identified as having semantic STM deficits being impaired on some language comprehension and production paradigms. In this experiment we use fMRI with healthy subjects to test predictions motivated by previous patient studies. Subjects were required to detect semantic anomalies in short phrases such as "green, bright, shining, sun". Semantic anomalies were manipulated such that they appeared either before ("green, bright, shining, sun") or after ("sun, shining, bright, green") a head noun. We found significantly greater activation in left inferior frontal and middle frontal gyri for phrases that required maintenance of multiple words for eventual integration with a subsequent noun (i.e., the "before" condition). These areas were similar to those reported in studies examining semantic STM (Martin et al., 2003). Post-hoc analyses revealed no effects between the two conditions in areas associated with phonological short-term memory. These data are consistent with previous patient studies (Martin & Romani, 1994; Martin & He, 2004) that associate semantic STM with the left inferior and middle frontal gyri and suggest that deficits of semantic STM have particular consequences for comprehension tasks that require maintenance of several word meanings in unintegrated form.

E108

THE ROLE OF MAINTENANCE MECHANISMS IN LEARNING TO ASSOCIATE TEMPORALLY DISCONTINUOUS ITEMS: A DEVELOPMENTAL INVESTIGATION Brian J. Kramer[1], J. Y. Davidow[2], Dima Amso[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Cornell Medical College, [2]Columbia University — A variety of constraints act to enhance and/or limit learning. We examined the role of the development of maintenance capacities in pairing temporally discontinuous items during learning of co-occurrences. We asked whether the ability to maintain the first item in a pair over a delay would serve as a learning constraint. A total of 65 children, adolescents, and adults participated in this eye tracking experiment. Two centrally presented cues predicted the location of peripheral targets with some probability (co-occurrences). Simultaneously, we varied the frequency with which each target is presented throughout the task (item occurrence). This required no contingent pairings and should be insensitive to the delay manipulation. In previous work, we found the hippocampus in concert with the prefrontal cortex to be involved in learning from environmental regularities. Subjects completed two identical learning blocks, one with a 250 millisecond delay and one with a 500 millisecond delay between cues and target locations. Subjects made an eye movement to item locations, with changes in saccade latency serving to index learning of the task structure. Data showed that the longer delay interval disrupted learning of co-occurrences for children and adolescents, but not adults. As predicted, simple item occurrences were learned equally well across age and delay interval, indicating specificity in the mediation of learning by maintenance systems. We predict that ongoing neuroimaging (fMRI) work will show this effect to be driven by changes in frontohippocampal interactions over development.

E109

THE PURE EFFECT OF IMAGERY GENERATION ON THE EVENT-RELATED BRAIN POTENTIAL Keiko Yamazaki[1], Jun'ichi Katayama[2]; [1]Hokkaido University, [2]Kwansei Gakuin University — Visual mental imagery generation affected early event-related brain potentials evoked by imagery cue and probe. In this study, we investigated whether this effect was observed during imagery generation without inspection by the probe, or not. Furthermore, we established working memory condition for confirming the effect is imagery specific. In the imagery condition (IMG), left or right arrow was presented. After that, blank screen was followed by bilateral 5 x 5 grids and imagery cue, which was one of small letters ("l", "t" as SIMPLE, and "g", "s" as COMPLEX trials) on the central cell of the grid. Participants visualized the block letter corresponding to imagery cue on the grid indicated by the arrow. 1500 ms after the cue offset, probe mark appeared at one of the cell, and participants decided whether or not the probe mark fell on the visualized shapes. In the working memory condition (WM), imagery cue was replaced by the block letter drawn on the grid, and participants maintained it for later decision. Choice reaction time confirmed that there was no difference in task difficulties between conditions. ERPs elicited by the imagery cue (IMG condition) and the block letter cue (WM condition) were estimated. While the side indicated by the arrow affected the early negative deflection in both conditions, the complexity of imagery cue affected the early negative deflection and later negative component only in the IMG condition. These results showed that the early imagery effect on the ERP was due to generation process specific to imagery.

E110

REMOVING IRRELEVANT INFORMATION FROM WORKING MEMORY: DOMAIN-SPECIFIC PRIORITIZATION TAKES TIME Andrew T. Drysdale[1], Jarrod A. Lewis-Peacock[1], Klaus Oberauer[2], Bradley R. Postle[1]; [1]University of Wisconsin, Madison, [2]University of Zurich — Working memory retention is supported by functionally distinct states of representation (e.g., Cowan, 1995). These include an "active" state enabled by a capacity limited direct-access region and a "passive" state consisting of re-activated portions of long-term memory. Transferring information into passive storage, so that its retention no longer affects processing latencies, can take several seconds (Oberauer, 2001, 2002). We sought to replicate this finding for stimuli maintained in phonological, visual, and semantic codes. Participants were presented briefly with two sets of visual stimuli for a subsequent memory judgment task. Next, one set was cued as relevant for subsequent memory judgment ("active set"), while the remaining set had to be remembered but not used for the judgment task ("passive set"). Stimuli consisted of real words, single-syllable non-words, and line segments. Each required a domain-specific response: a synonym judgment, a rhyme judgment, and an orientation judgment, respectively. Neuroimaging results (Lewis-Peacock et al., this meeting) suggest these stimuli were maintained during the delay period in a domain-specific manner. When stimulus sets were of the same type, response latencies were initially sensitive to size of both the active and passive sets, but became insensitive to the size of the passive set after 4 s. This pattern of results shows that uncued stimuli can be removed from the direct-access region within a few seconds. We observed similar results when stimulus sets were of different types (e.g., line segments and words), suggesting a domain-general mechanism underlying the prioritization of information in working memory.

E111

FUNCTIONALLY DISTINCT STATES OF WORKING MEMORY RETENTION ARE REVEALED BY PATTERN CLASSIFICATION OF FMRI Jarrod A. Lewis-Peacock[1], Andrew T. Drysdale[1], Klaus Oberauer[2], Bradley R. Postle[1]; [1]University of Wisconsin, Madison, [2]University of Zurich — One theoretical account of working memory suggests that the short-term retention of information relies on re-activations of long-term memory (aLTM) (e.g., Anderson, 1983; Cowan, 1995). A subset of activated items can be held in a capacity limited direct-access region or a single item held in the focus of attention. Information no longer relevant for processing can be removed from the direct-access region within several seconds, while still retained in aLTM (Oberauer, 2001, 2002). We searched for neural correlates of these theorized states during a delayed-response task with fMRI. First, we trained a pattern classifier to distinguish brain activity corresponding to the short-term retention of phonological, semantic, and visual information. Then, this classifier was used to decode brain activity from a subsequent task that required prioritization of the contents of working memory. Participants were briefly presented two visual stimuli drawn from two of three possible categories: non-words, real words, and line segments. Following a brief delay, one stimulus was cued for a later comparison task ("active" stimulus), while the other had to be remembered but not used for the comparison ("passive" stimulus). Results showed high classifier estimates for the active stimulus following the cue, while estimates for the passive stimulus fell to baseline. Critically, activity corresponding to the passive stimulus re-emerged if that stimulus was cued later in the trial for a second comparison. This pattern of results supports a key tenet of aLTM theories that information can be temporarily removed from the direct-access region while being retained in aLTM.

E112

WILL COMPUTERIZED WORKING MEMORY TRAINING IMPROVE OBSERVABLE ADHD BEHAVIOR? Chloe Green[1], Debra Long[1], David Green, Meghan Miller[2], Faye Dixon[1], Catherine Fassbender[1], Julie Schweitzer[1]; [1]University of California, Davis, MIND Institute, [2]University of California, Berkeley — Impaired working memory is a central deficit in ADHD. A computerized training program, Cogmed, has been shown to increase working memory capacity in children with ADHD. It is not known whether the training improves behavior associated with classroom learning, such as remaining on-task and inhibiting off- task behavior. The aim of this study was to utilize ecologically valid measures to investigate training's effect on observable ADHD behavior. Method: The current study took place at the UC Davis MIND Institute. The study was randomized, double-blind, placebo-controlled, and includes data from twenty-six children (7-14 yrs old) diagnosed with ADHD. Off-task behavior was measured using an observational assessment tool, the Restricted Academic Setting Task (RAST), before and after training. This dependent variable (the RAST) simulates the academic setting and is often used to measure the efficacy of ADHD medications. Pre/Post teacher and parent ADHD rating scales, standardized working memory tests and achievement fluency tests were other outcome measures. Results: Five weeks of working memory training led to significant improvement on non-trained working-memory tests and on "off-task" ADHD associated behavior on the RAST. There was no significant improvement on achievement fluency tasks immediately following training. Findings lend insight into the generalizability of working memory training's effects and the relationship between deficits in working memory and off- task behavioral components of ADHD.

E113

REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION OF THE POSTERIOR SUPERIOR TEMPORAL GYRUS MODULATES TASK-RELEVANT THETA OSCILLATIONS IN VERBAL WORKING MEMORY Daniel Acheson[1], Bradley Postle[1]; [1]University of Wisconsin, Madison — Repetitive transcranial magnetic stimulation (rTMS) of language production-related brain regions of the perisylvian cortex reliably disrupts verbal working memory (WM) performance. However, the neural bases of this effect remain unknown. The goal of the present study was to combine online EEG recording with functionally-guided rTMS to examine the effects of rTMS on oscillatory brain activity associated with verbal WM performance. First, fMRI was used to elicit activation in the posterior superior temporal gyrus (pSTG) as subjects performed overt picture naming. Second, the pSTG and the leg area of somatosensory cortex (S1; a cortical control area) were then targeted with rTMS as subjects performed delayed serial recognition of pseudoword stimuli (e.g., rof, gup, etc). 10 Hz rTMS was applied unpredictably on half of the trials during a 3 second delay period, and EEG activity was recorded with a 60 channel, TMS compatible cap. Prior to data analysis, independent components analysis was used to remove nonphysiological, rTMS-related artifact. Results showed that rTMS of the pSTG led to a significant reduction in theta-band (4-8 Hz) spectral power, whereas rTMS of the control region (S1) had no such effect. More importantly, at both frontal and parietal electrode cites, individual differences in the magnitude of the change in theta-band power induced by rTMS of the pSTG predicted the magnitude of rTMS-related changes in both accuracy and reaction time across subjects. These results thus provide some of the first evidence of a causal role for theta oscillations in maintaining information in verbal WM.

E114

NEURAL CORRELATES OF N-BACK TRAINING – A PSEUDO-CONTINUOUS ARTERIAL SPIN LABELING (PCASL) STUDY Susanne Jaeggi[1], Martin Buschkuehl[1], Luis Hernandez[1], Jessica Bernard[1], John Jonides[1]; [1]The University of Michigan — We investigated the neural correlates of a working memory training by using a quantitative measure of cerebral blood flow, i.e. pseudo-continuous arterial spin labeling (pCASL). Participants trained for 7 sessions on a spatial version of an adaptive n-back paradigm. Before and after training, we scanned participants contrasting their performance on an easy and on a hard version of the trained n-back task (1-back vs. 4-back). We observed a large training effect which was consistent with a significant performance increase in the pre- and post-test scanning sessions in the 4-back task: In the pre-test, participants were performing close to floor-level, whereas their performance was > 80% correct at post-test. This performance increase was accompanied by a decrease in activation in (right) dorsolateral prefrontal cortices, but also, by an increase of bilateral activation in posterior parietal regions. This shift from anterior to posterior networks suggests a reorganization as a function of training gain reflecting neural plasticity.

E115

THE INFLUENCE OF DOPAMINE TRANSPORTER GENOTYPE ON WORKING MEMORY PLASTICITY Helena Westerberg[1], Yvonne Brehmer[1], Martin Bellander[1], Daniel Fürth[1], Sari Karlsson[1], Lars Bäckman[1]; [1]Karolinska Institute, Stockholm, Sweden — Specific goals To investigate if an indirect measure of striatal DA availability, the DAT1 polymorphism, affect training induced plasticity of working memory (WM). Methods used A group of 29 healthy adults (M 26.0, SD 2.8 years) performed cognitive testing and received four weeks of adaptive training of WM implemented by a computerized program (CogmedQM). In addition to cognitive testing and training a blood sample were drawn from each participant for analysis of functional polymorphisms related to WM. Since Dopamine (DA) is implicated in (WM) functioning we were interested in variations in the DA transporter (DAT1) gene (SLC6A3), which regulate DA availability in striatum. Compared to DAT1 9/10- repeat carriers, homozygosity of the DAT1 10-repeat allele is related to less availability of extra neuronal dopamine. We also controlled for individual variants of the COMT Val158Met polymorphism. Summary of the results and conclusion At baseline the two groups were indistinguishable in WM performance as well as in tests assessing different cognitive abilities. All participants improved their performance as a function of training. However, DAT1 9/10-repeat carriers showed larger training-related gains than DAT1 10-repeat carriers in visuospatial WM. This result provides novel evidence that WM plasticity is a more sensitive indicator of DAT1 gene-related cognitive differences than single-assessment performance scores. Investigating cognitive plasticity in relation to imaging genomics is an unexplored approach in delineating the relationship among genes, brain, and behavior. To our knowledge, this is the first study to demonstrate a modulating effect of a genetic polymorphism on cognitive plasticity.

E116

CONCURRENT TASK PERFORMANCE REDUCES THE MAGNITUDE BUT NOT THE FREQUENCY OF TMS-EVOKED NATURAL FREQUENCY ESTIMATES Jeffrey Johnson[1], Mario Rosanova[2], Marcello Massimini[2], Bradley Postle[1]; [1]University of Wisconsin-Madison, [2]University of Milan — A recent study using transcranial magnetic stimulation (TMS) to perturb specific corticothalamic circuits (extrastriate cortex, superior parietal lobule (SPL), premotor cortex), and EEG to measure the resultant evoked responses, demonstrated that each resonated at a distinct 'natural frequency' (8-12 Hz, 13-20 Hz, and 21-40 Hz, respectively) when participants were at rest (Rossanova et al., 2009). What remains unknown, however, is whether a region's natural frequency varies with behavioral context. That is, do natural frequency estimates for a given brain area change in systematic ways when that brain area is involved in the performance of a task? In the present study, we explored this possibility by replicating the methods of Rossanova et al. (i.e., perturb with TMS and measure while subjects are at rest) and adding a condition in which TMS was delivered to the SPL during the delay period of a spatial delayed-recognition task. We focused on the SPL because of its known involvement in spatial memory tasks. Because previous studies have revealed sustained increases in the power of posterior alpha-band oscillations throughout the delay period of such tasks, we hypothesized that the task-related natural frequency estimate would shift downwards towards the alpha band. Contrary to this prediction, however, we found that natural frequency estimates were identical in frequency across rest and task conditions, but were smaller in magnitude when TMS was applied during the delay. This finding suggests that a brain region's natural frequency may be a stable property that does not vary with more transient, task-specific network dynamics.

E117

ELECTROPHYSIOLOGICAL DIFFERENCES IN THE FORMATION OF AUDITORY IMAGES Ana Navarro Cebrian[1], Petr Janata[1]; [1]UC Davis, Center for Mind and Brain — Deciding whether a note is in tune within a musical context is an easy task for some people and very difficult for others. In this experiment, participants judged the intonation of the last note of a musical scale in both a top-down task in which the notes before the last note had to be imagined and a task in which the image for the target was driven bottom-up by the perception of the preceding notes in the scale. First, good and bad performers in the tasks were compared using ERP recordings. A stronger activity related to working memory (WM) was found during the formation of images for good performers. Secondly, differences in the activity for image formation modulated the cortical potentials evoked by the deviated tone (N100). In addition, both tasks were compared to demonstrate that the acuity of an auditory image is comparable to that of a sensory memory trace to the point of evoking similar neuronal responses. Finally, the influences of long-term memory on WM and the consequent formation of accurate images was further studied. It has been demonstrated that the tonal structure that governs the relationships of individual notes to a primed key context is implicitly learned by exposure to music. We found that images were more accurate for those items more related to the tonal context.

E118

LEARNING CHUNKING HIERARCHIES IN NON-MOTOR (COGNITIVE) SEQUENCES Anne B. Kühn[1], D. Yves von Cramon[1], Ricarda I. Schubotz[1]; [1]Max Planck Institute for Neurological Research — Memorizing sequences requires structural analyses and optimization by chunking sequence elements. To study networks mediating the acquisition of sequential chunks at different hierarchical levels, the present functional magnetic resonance imaging (fMRI) study investigated learning of hierarchical 16-digit-sequences by trial and error in a cognitive serial learning paradigm. Sequences were learned and then scrambled to different extends (disruption of higher chunk levels (CL) while keeping lower CL intact). Learning of scrambled CL was hypothesized to isolate neural activity specific to different CL. We expected activation of the frontal operculum (FOP) for adjacent digits and of the supplementary motor area (SMA) for the highest CL. Behaviorally, chunking was expressed by higher error rates and longer reaction times for higher as compared to lower CL. Different highpass filter cut-offs (1/125 Hz versus 1/620 Hz) were employed to analyze learning of short (low CL) and large (high CL) subsequences. This approach revealed a double dissociation: lowest CL were reflected by fast changing activation of left FOP, whereas highest CL by slow changing activation of SMA. Moreover, mesial Brodmann Area (BA) 9 was found for the highest CL. Findings point to a frequency- and level-dependent chunking network. In particular, data suggest the FOP to contribute to the acquisition of local dependencies, BA 9 to integration of already sub-chunked information and building up of coherences, and SMA to store sequence knowledge.

E119

TRACKING THE EVOLUTION OF THE MEMORY TRACE FOR VISUAL MOTION IN HUMAN CORTEX USING MULTIVOXEL PATTERN ANALYSES Adam C. Riggall[1], Bradley R. Postle[1]; [1]University of Wisconsin, Madison — Working memory, the ability to retain and manipulate information no longer present in the environment, is a fundamental contributor to higher-level cognition. While often thought to require specialized cortical systems, particularly those in prefrontal cortex (PFC), recent research has shown working memory may arise through the coordinated recruitment of brain systems involved in sensory, representational, and action-related functions. Recent monkey electrophysiology work (Zaksas & Pasternak, 2006) using a delayed-recognition task for motion direction suggests such a cortical network, with low-level sensory information represented in the middle temporal visual area (MT) and task-related representations appearing in PFC during the memory delay. Here we examined the short-term storage of motion information in human cortex using functional magnetic resonance imaging (fMRI). Subjects were scanned while performing a delayed-recognition task for direction of coherently moving random dot stimuli. These data were analyzed using a whole-brain searchlight approach (Kriegeskorte et al. 2006), in which a pattern classifier was repeatedly trained to discriminate motion directions using local patterns of activity centered on each voxel. The classifier was then used to guess the remembered direction during each time point of the delay period during an independent run of the task. It also discriminated categorical from sensory representations of direction. This approach allowed us to assess within local areas of cortex how the representation of the stimuli evolved throughout the delay period, letting us separate areas that represent low-level sensory features from those that develop over time to represent task-relevant response-based representations.

Long-Term Memory: Episodic

F1

ELECTROPHYSIOLOGICAL EVIDENCE THAT THE FINE-GRAINED TEMPORAL STRUCTURE OF SUBJECTIVE EXPERIENCE IMPACTS THE FORMATION AND RETRIEVAL OF EPISODIC MEMORIES Joanne L. Park[1], David I. Donaldson[1], Kevin Allan[2]; [1]University of Stirling, [2]University of Aberdeen — It is widely accepted that episodic memory is essentially associative, producing memory traces from multiple elements of an event that must be bound together in space and time, and that must be extracted from the continuously changing stream of subjective experience. The key question addressed by this study is whether the fine-grained temporal structure of subjective experience has an impact on the formation and retrieval of episodic memories. Temporal structure was manipulated by varying the time between words within a word-pair to be encoded at study, and Event Related Potentials (ERPs) were employed to measure the effect of this manipulation during retrieval in an associative recognition task. The behavioural results revealed that associative recognition was significantly enhanced when episodes comprised of a pair of words separated by a brief temporal gap, compared to episodes comprising a simultaneously-presented pair of words. ERP results revealed a corresponding relationship between the temporal structure of the encoded information and the timing of retrieval processes, such that retrieval appeared to be delayed in onset for pairs studied with a brief temporal gap compared to simultaneous pairs. Taken together, the findings suggest that the fine-grained temporal structure of subjective experience is retained in an episodic representation, and does impact the retrieval of episodic memories.

F2

FROM CONCEPTUAL RELATIONS TO ASSOCIATIVE MEMORY: AN EVENT-RELATED POTENTIAL STUDY Olga Kukina[1,4], Axel Mecklinger[1,4], Xuchu Weng[2,4], Jiongjiong Yang[3,4]; [1]Saarland University, Saarbrücken, Germany, [2]Chinese Academy of Sciences, Beijing, China, [3]Peking University, Beijing, China, [4]International Research Trainign Group "Adaptive Minds" — Cross-cultural research on categorization showed that while Westerners prefer taxonomic groupings (e.g., policeman-postman), East-Asians tend to form thematic ones (e.g., policeman-uniform). These results imply differential weighting of the taxonomic/thematic relations in the conceptual system of Westerners/Asians and if so, should be reflected in the differential modulation of the N400 component for the two relation types. We assumed that these differences in the conceptual system also affect associative episodic memory. For Westerners (Germans), the retrieval of thematically-related associations should be quite demanding and therefore mostly relying on a slow mnemonic process, i.e. recollection. In contrast, the retrieval of taxonomic associates should benefit from the underlying conceptual system and could be additionally supported by a fast automatic process, i.e. familiarity. In an ERP-experiment, German participants memorized lists of taxonomically/thematically-related and unrelated word pairs. Subsequently associative memory was tested by asking whether the presented word pair was old, rearranged or new. ERPs recorded in the study phase show a gradient pattern for the N400. It is attenuated for both relation types relative to unrelated pairs with the largest modulation observed for taxonomic associates. This suggests that the two relation types are dissociated in the conceptual system. Behavioral results on the memory task reveal higher recognition accuracy for old taxonomic than thematic associates. The ERP-data also show differential involvement of familiarity and recollection for taxonomic and thematic pairings implicating that the conceptual system interacts with associative memory. A subsequent experiment will be conducted with Chinese participants to enable the cross-cultural comparison.

F3

MEMORY FOR OBJECTS RELEVANT FOR NAVIGATION IN ALZHEIMER PATIENTS Roy Kessels[1,2,3], Amy van Doormaal[1,3], Gabriele Janzen[1,3,4]; [1]Radboud University Nijmegen, [2]Radboud University Nijmegen Medical Centre, [3]Donders Institute for Brain, Cognition and Behaviour, [4]Behavioural Science Institute — In spatial navigation, landmark recognition is crucial. Specifically, memory for objects placed at decision points on a route is relevant. Previous fMRI research in healthy adults showed higher medial-temporal lobe (MTL) activation for objects placed at decision points compared to non-decision points, even at an implicit level. Since there is evidence that implicit learning is intact in amnesic patients, the current study examined memory for objects relevant for navigation in patients with Alzheimer dementia (AD). 21 AD patients participated with MTL atrophy assessed on MRI (mean MMSE=21.2, SD=4.0), as well as 20 age- and education-matched non-demented controls. All participants watched a 4-min video showing a route through a virtual museum with 20 objects placed at intersections (decision points) and 20 at simple turns (non-decision points). The instruction was to pay attention to the toys (half of the objects) for which they were supposedly tested later. Subsequently, a recognition test followed with the 40 previously presented objects among 40 distracter items (both toys and non-toys). Results showed a better performance for the non-toy objects placed at decision points than non-decision points, both for AD patients ($p<0.001$) and controls ($p<.05$). This indicates that AD patients with MTL damage have implicit memory for object information relevant for navigation. No decision point effect was found for the attended items. It may be that focusing attention on the items occurred at the cost of the context information in AD, whereas the controls performed at an optimal level due to intact memory function.

F4

ON BECOMING OLD BEFORE YOUR TIME: DISRUPTING ENCODING IN YOUNG ADULTS PRODUCES AN EPISODIC MEMORY DEFICIT THAT MIMICS THAT IN OLDER ADULTS David Friedman[1], Doreen Nessler[1], Ray Johnson Jr.[2]; [1]New York State Psychiatric Institute, [2]Queens College of the City University of New York — Older adults typically exhibit episodic-memory deficits, but the extent to which this is due to encoding- or retrieval-related deficiencies is unclear. Semantic elaboration during encoding is critical to the formation of contextually-rich episodic memories because it enables greater use of recollection- compared to familiarity-based retrieval processes. Nessler et al. (2006) found that a left inferior prefrontal cortex (LIPFC) ERP negativity (between 400 and 1400 ms), which reflects semantic elaboration, was reduced in the elderly. This reduced LIPFC activity was associated with reductions in both memory performance and the left-parietal episodic memory (EM) effect, a putative index of recollection. The mid-frontal EM effect, presumed to measure familiarity, was age invariant. These findings raise the possibility that the elderly's retrieval performance and altered brain activity is causally related to their reduced LIPFC activity during encoding. We tested this hypothesis by disrupting encoding-related processes in early (300-850 ms) and late (850-1400 ms) intervals when the LIPFC negativity is present. Young adults made semantic decisions on to-be-remembered nouns while simultaneously detecting infrequent auditory targets when tones were present. ERPs were recorded during a subsequent Yes/No recognition test. Compared to no-tone trials, distracting tones produced an "age-related recognition deficit" in the young. This behavioral deficit was accompanied by the same altered pattern of brain activity seen in the elderly during retrieval: reduced left-parietal EM effect but no change in mid-frontal EM effect. We conclude that at least part of the episodic-memory deficit observed in older adults is attributable to reduced LIPFC activity during encoding.

F5

ESTABLISHING THE BOUNDARIES: THE HIPPOCAMPAL CONTRIBUTION TO IMAGINING SCENES Chris M. Bird[1,2], Corinne Capponi[1,3], John A. King[4], Christian F. Doeller[1,2], Neil Burgess[1,2]; [1]UCL Institute of Neurology, London, UK, [2]UCL Institute of Cognitive Neuroscience, London, UK, [3]Bioimaging Institute of Advanced Biomedical Technologies G. D'Annunzio University, Chieti, Italy, [4]UCL Clinical, Educational and Health Psychology, London, UK — When we visualise scenes, either from our own past or invented, we impose a viewpoint for our "mind's eye" and we experience the resulting scene as spatially coherent. Recent research has implicated the hippocampus in imagining future and fictitious events as well as retrieving past experience. We tested a specific hypothesis based on the spatial firing properties of neurons in the hippocampal formation that this region supports construction of spatially coherent mental images by representing the surrounding environmental boundaries. Using fMRI we show that hippocampal activation increases parametrically with the number of enclosing boundaries in the imagined scene. This activity is unrelated to the spatial or non-spatial complexity of the scenes or to task difficulty. Our findings support a specific computational role for the hippocampus in mental imagery and episodic recollection.

F6

CONTENT-SENSITIVE NOVELTY ENCODING IN THE MEDIAL TEMPORAL LOBE: INSIGHTS FROM HIGH-RESOLUTION FMRI AND DISTRIBUTED PATTERN ANALYSIS Jackson C. Liang[1], Anthony D. Wagner[2], Alison R. Preston[1]; [1]University of Texas at Austin, [2]Stanford University — The ability to distinguish between novel and familiar stimuli plays a critical role in orienting toward behaviorally salient and rewarding events. Current theories of medial temporal lobe (MTL) function propose that distinct MTL regions may differ in their sensitivity to novelty based on information content. For example, the anatomical projections between sensory processing regions and perirhinal and parahippocampal cortices suggest that these regions are sensitive to visual object and visuospatial content respectively. However, the representation of different stimulus content need not be modular and may instead be distributed in a graded manner both within and across subregions. To answer this question, we employed high-resolution functional MRI and an incidental novelty detection task using five stimulus classes (faces, scenes, visual words, spoken words, sounds). Univariate statistics revealed a graded distribution of face and scene novelty responses along the anterior-posterior axis of MTL cortex. Novelty responses in hippocampus were isolated to the anterior subfields and were similar across content. Additional multi-voxel pattern analyses revealed that despite overall sensitivity to specific content, MTL cortical regions maintained an ability to classify information of non-preferred content. In contrast, hippocampal subfields DG/CA3 and CA1 failed to accurately discriminate between different content types, though subiculum demonstrated significant classification accuracy for faces and scenes. Together, these findings support a graded distribution of content-sensitive novelty responding along the anterior-posterior axis of MTL cortex and provide evidence for content-general novelty encoding in the hippocampus.

F7

CONTENT-SPECIFIC REACTIVATIONS IN VISUAL CORTEX DURING MEMORY RETRIEVAL Christoph Hofstetter[1], Amal Achaibou[1], Sebastian Rieger[1], Chiara Cristinzio[1], Patrik Vuilleumier[1,2]; [1]University Medical Center, University of Geneva, Switzerland, [2]Swiss Center for Affective Sciences, University of Geneva, Switzerland — Studies on memory suggest that a subset of cortical regions implicated in stimulus encoding may be reactivated during subsequent retrieval, involving visual or auditory areas for visual or auditory memories, respectively. However, the content specificity of such reactivations is still unclear. Some brain regions are specialized in processing distinct visual objects categories, such as faces, places, and words. In our study we used functional magnetic resonance imaging (fMRI) to test for face and word specific reactivations during a memory task. The experiment consisted of a learning phase and a test phase in which participants learned pairs of stimuli. A pair consisted of either a scene and a face, or a scene and a word. The content of scenes was variable, containing objects, landscapes, and/or houses, but did not contain faces or words. In the test phase we presented scenes only (one in turn), and participants had to indicate whether this image was previously paired with a face, a word, or was new. Preliminary fMRI results for the test phase showed activations in a functionally defined face-responsive region in the right fusiform gyrus, as well as in a region activated by words in the left inferior temporal gyrus, for scenes previously paired with faces and words, respectively. The results support the idea of cortical memory reactivations, even at a content-specific level, and are consistent with other results concerning mental imagery.

F8

REMEMBERING TO ATTEND: SEPARATING ATTENTION AND MEMORY SIGNALS IN POSTERIOR PARIETAL CORTEX Melina Uncapher[1], Sarah DuBrow[1], J Benjamin Hutchinson[1], Anthony Wagner[1]; [1]Stanford University — While attention and declarative memory dynamically interact, the nature of these interactions remains underspecified. Recent proposals suggest that the consistent observation of functional activation in posterior parietal cortex (PPC) during episodic retrieval may reflect the engagement of attention mechanisms. However, a central tenet of these proposals is currently under debate; namely, whether separate attention and memory mechanisms exist in PPC, or whether PPC attention mechanisms are engaged in service of retrieval (by setting the stage for and then acting on the contents of memory during retrieval). To test these competing hypotheses, the present fMRI study incorporated an attentional orienting manipulation into a memory retrieval paradigm. Volunteers were scanned while being cued to orient attention to locations within trial-unique scenes in which trial-unique objects had been studied. To separate memory and attention effects in PPC, memory-based expectations (about object-scene and/or object-location associations) were either met or violated. We predicted functional heterogeneity in PPC, such that (1) dorsal PPC would exhibit top-down attentional orienting effects (when cues to shift spatial attention appeared), (2) temporo-parietal junction would exhibit reflexive attentional reorienting effects (when expectations were violated), and (3) angular gyrus would exhibit memory recollection effects (when associative information was successfully retrieved). BOLD data revealed all three patterns, indicating that dorsal and ventral PPC attention mechanisms do not fully account for parietal activation during episodic retrieval. Rather, additional PPC mechanisms appear to be specifically engaged when retrieving associative information from memory. These findings add to an emerging literature indicating high functional heterogeneity within PPC.

F9

THE ROLE OF WORKING MEMORY IN THE ACTIVE INHIBITION OF COMPETING REPRESENTATIONS IN LONG TERM MEMORY: NEURAL AND BEHAVIOURAL EVIDENCE Rachael Elward[1], Edward Wilding[1]; [1]School of Psychology, Cardiff University, Cardiff — Cognitive control operations are assumed to be engaged during memory retrieval. Working memory capacity (WMC) is also assumed to be required for effective cognitive control, and if this is correct then WMC should predict when cognitive control over retrieval occurs. To test this, young adults (N=48) were divided into high and low WMC groups on the basis of Operation Span scores. In a retrieval task in which event-related potentials (ERPs) were acquired, participants responded "old" to one class of studied items (targets) while rejecting another class (non-targets) along with unstudied items. Larger left-parietal ERP old/new effects (an ERP index of recollection) for targets than for non-targets have been interpreted as evidence for prioritisation of recollection of target information, and this pattern was evident only for members of the high WMC group. Moreover, after this task, participants recalled as many studied words as possible. Only high WMC participants recalled reliably fewer non-targets than targets. The ERP data ties the engagement of strategic retrieval operations to the resources necessary to exert cognitive control, and the recall data suggests that strategic control is exerted by inhibiting information associated with non-targets. Finally, half of the high WMC participants completed 'resource depleting' task (a Stroop task) before the retrieval task. These participants showed no evidence of strategic recollection neurally or behaviourally, suggesting that cognitive control is a normal part of memory search in participants with sufficient WMC. Deficits in recollection seen in older adults and some clinical populations may be explained by WMC.

F10

INTERACTIONS OF THE HIPPOCAMPUS AND INFERIOR PARIETAL CORTEX DIFFER BETWEEN ENCODING AND RETRIEVAL OF RELATIONAL INFORMATION: ANATOMICAL AND FUNCTIONAL CONNECTIVITY ANALYSES Cornelia McCormick[1,2,3], Morris Moscovitch[2,4], Andrea B. Protzner[1,2], Christian G. Huber[3], Mary Pat McAndrews[1,2]; [1]Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, [2]University of Toronto, ON, Canada, [3]University Medical Center, Hamburg-Eppendorf, Germany, [4]Rotman Research Institute, Baycrest Centre, Toronto, Canada — Encoding and retrieval of relational information is thought to require interaction between the hippocampus and various neocortical regions, but it is unclear whether the connectivity of hippocampal-neocortical networks is different at input and output stages. To examine this, we conducted a network analysis of event-related fMRI data collected during a face recognition (remember/know) paradigm. Region-of-interest analyses identified a small region in the left hippocampus that showed differential activation for both encoding and retrieval of recollected versus familiar items. Multivariate seed partial least squares (PLS) analysis was used to identify brain regions that were functionally connected to this hippocampal region at encoding and at retrieval of 'remembered' items. Anatomically-based structural equation modeling (SEM) was then used to test for differences in effective connectivity of network nodes between these two memory stages. The SEM analysis revealed very few differences except for a reversal of directionality between the left hippocampus (LHC) and left inferior parietal cortex (LIPC). During encoding, activation of the LHC had a positive influence on the LIPC, whereas during retrieval the reverse pattern was found, i.e., the LIPC activation positively influenced the degree of LHC activation. These findings emphasize the importance of the hippocampal-parietal connections in initial binding and retrieval/reintegration of relational memory, suggesting a complex dialogue between these regions that will help to inform our understanding of parietal contributions to relational memory.

F11

TOP-DOWN AND BOTTOM-UP ATTENTION-TO-MEMORY: DELINEATION OF TWO FUNCTIONAL NEURAL NETWORKS Hana Burianova[1,2], Elisa Ciaramelli[2], Cheryl L. Grady[2], Morris Moscovitch[2]; [1]Macquarie University, Macquarie Centre for Cognitive Science, Sydney, Australia, [2]University of Toronto, Canada — The objective of this study was to provide further support for the Attention-to-Memory (AtoM) hypothesis, which purports a distinction between the mnemonic roles of dorsal and ventral parietal cortices. In a recent experiment, we examined whether dorsal parietal cortex (DPC) allocates effortful top-down attention to memory retrieval, and whether ventral parietal cortex (VPC) mediates spontaneous bottom-up capture of attention by memory. Participants studied word pairs and responded to target (studied) words among new words. In some conditions, recognition was facilitated by cueing of the target by a studied word of the same pair; in other conditions, no cue was provided. Left DPC was activated upon presentation of a valid cue, whereas left VPC was activated upon presentation of a non-cued target. Here, we aimed to determine whole-brain functional connections with these two posterior parietal regions. In response to a memory cue, the left DPC was functionally connected with a number of dorsal attention areas, including superior and inferior parietal areas, precentral gyrus, ventral and dorsolateral prefrontal cortices, and with the left hippocampus. In response to a non-cued target, the left VPC was functionally connected with ventral attention areas, including inferior and middle frontal gyri, superior temporal gyrus, insula, and inferior parietal lobule, and the ventral visual pathway. These results are consistent with the hypothesis of two functional networks subserving attention to memory, a top-down AtoM network correlating with activity in the left DPC, and a bottom-up AtoM network correlating with activity in the left VPC.

F12

AN ERP STUDY OF THE MODULATION OF ENCODING TASKS ON THE MIRROR EFFECT INDUCED BY THE SEMANTIC TRANSPARENCY OF CHINESE TWO-CHARACTER WORDS Yi-Jhong Han[1], Shih-kuen Cheng[1], Ovid J-L. Tzeng[1,2], Daisy L. Hung[1]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan, [2]Institute of Linguistics, Academia Sinica, Taiwan — In a previous study that employed lexical decision as the encoding task, a mirror effect was observed in the recognition of semantically transparent and opaque Chinese two-character words. Opaque words [e.g., "?(/yang/, sun)?(/chun/, spring)", plain] elicited a higher hit rate and a lower false alarm rate than transparent words [e.g., "?(/cha/, tea)?(/bei/, cup)", teacup]. Both behavioral and ERP data indicated that the hit-rate part of the mirror effect results from the greater recollection for opaque words. The current study examined whether the difference in recollection for these two types of words was because opaque words intrinsically elicit more elaborative processing than transparent ones. We used encoding tasks that demands semantic processing to ensure that both types of words were processed elaboratively. The greater recollection for opaque words remained when concreteness rating was used as the encoding task, suggesting that elaborative processing was not the only reason for the better recollection of opaque words. When transparency judgment was employed as the encoding task, both the hit rates and the false alarm rates were statistically identical for transparent and opaque words. ERPs data showed reliable mid-frontal and left-parietal old/new effects, both of which were not modulated by the semantic transparency of the test items. We argue that the transparency rating task led participants to encode each constituent member of the Chinese two-character words hence diminished the distinctiveness of the opaque words resulted from their morphological structures.

F13

EFFECTS OF UNILATERAL THALAMIC STROKES ON RECOGNITION MEMORY Giulio Pergola[1,3], Benno Koch[2], Michael Schwarz[2], Irene Daum[1]; [1]Institute of Cognitive Neuroscience, Bochum, [2]Klinikum Dortmund, [3]International Graduate School of Neuroscience, Bochum — The thalamus is known to be involved in declarative memory, but how exactly? Aggleton and Brown (1999) proposed that the anterior thalamic nuclei (AN), together with the hippocampus, support recollection, whereas the mediodorsal nucleus of the thalamus (MD) and the cortex of the parahippocampal gyrus participates in familiarity. Other dichotomies have been proposed, e.g. encoding in the AN versus retrieval in the MD (Van der Werf et al. 2003). The aim of this study was to test these hypotheses through a behavioural experiment with patients having suffered focal ischemic lesions, as assessed using high-resolution scanning facilities. The subjects were shown pairs of pictures and they had to learn them by association. Pictures belonged to one of the categories: animal, tool, scene. In the test phase subjects were presented with mixed studied and unstudied single pictures. The task was to make an old/new judgement (tapping both familiarity and recollection), and in case the picture was old, subjects named its counterpart using the first as cue (i.e., a recollection judgement occurred) and the category it belonged to. Eight patients with MD and five with AN lesions were tested and compared with a larger sample of healthy subjects. The data challenge Aggleton & Brown's hypothesis: patients were not impaired at recognition. Impairments in cued retrieval were significant in both groups. The patients in MD group were able to retrieve at least the category above guessing threshold, while the AN group patients were not, supporting Van der Werf's hypothesis.

F14

REDUCED EFFICIENCY OF NEURAL NETWORKS INDEPENDENT OF STRUCTURAL IMPAIRMENT: A SMALL-WORLD ANALYSIS OF FUNCTIONAL CONNECTIVITY PATTERNS IN SCHIZOPHRENIA Liang Wang[1,2], Paul Metzak[1,2], Jennifer Whitman[1,2], Todd Woodward[1,2]; [1]University of British Columbia, [2]BC Mental Health and Addicitions Research Institute — Brain networks are thought to be organized according to "small-world" topologies, whereby an optimal balance between local and global connections is required. In schizophrenia, the small-world configurations have been found to be sub-optimal. However, whether or not this reduced optimization is secondary to structural impairment has not yet been determined. To investigate this, 27 schizophrenia patients and 37 healthy controls were asked to indicate which of four operations they previously performed in response to the presented words (read, heard, semantically associated, or rearranged letters). Functional networks underlying correct trials were constructed and analyzed using graph theoretical approaches. We found that patient and control groups exhibited similar activations for the contextual memory task. However, functional networks revealed decreased local efficiency in the schizophrenia group. Additionally, compared with healthy controls, decreased gray matter volumes in schizophrenia patients were found in prefrontal cortex, insula and occipital cortex, which partially overlapped with the functionally activated regions. Subsequently, the activated regions were categorized into two sets on the basis of the presence or absence of gray matter volume abnormalities. Then functional networks of each set were separately analyzed using graph theory. Similar results (decreased local efficiency in schizophrenia) were observed for regions that did not show structural deficits, whereas slightly increased local efficiency in schizophrenia was seen for regions with structural deficits. This study suggests that abnormal functional reorganization, independent of aberrant brain structure, characterizes schizophrenia during contextual memory tasks.

F15

SLEEP LEADS TO QUALITATIVE CHANGES IN THE EMOTIONAL MEMORY TRACE: EVIDENCE FROM FMRI Jessica Payne[1,2], Elizabeth Kensinger[3,4]; [1]University of Notre Dame, [2]Harvard Medical School, Beth Israel Deaconess Medical Center, [3]Boston College, [4]Athinoula A. Martinos Center for Biomedical Imaging — After new information is encoded into memory, it continues to be processed and transformed during an offline period of consolidation that may occur optimally during sleep. The consolidation process solidifies memories, making them resistant to interference and decay, but emerging behavioral evidence suggests that it can also change memories in ways that make them more useful and adaptive. Here, we provide neural evidence that qualitatively distinct systems modulate the retrieval of emotional memories following delay intervals containing nocturnal sleep and daytime wakefulness. Although two regions within the hippocampus were strongly activated during successful retrieval of negative objects regardless of delay interval, there were pronounced differences in other regions following sleep vs. wake. A diffuse memory network – including widespread activity in the lateral prefrontal and parietal cortices as well as the medial temporal-lobe – corresponded more strongly to successful retrieval of negative items following wakefulness relative to sleep. By contrast, a much more refined and restricted network of limbic regions – including the amygdala, ventromedial prefrontal cortex, and cingulate gyrus – showed a stronger relation to successful retrieval of negative items after a period of sleep compared to a period of wakefulness. In addition, effective connectivity analyses revealed stronger connections in regions associated with emotional memory retrieval following sleep vs. wake. These data provide strong evidence that the qualitative behavioral changes in memory that are observed following a single night of sleep are mirrored by corresponding changes in the brain.

F16

THE EFFECT OF VALENCE AND DELAY ON MEMORY: AN FMRI ANALYSIS Katherine Schmidt[1,2], Katherine R. Mickley Steinmetz[1,2], Elizabeth A. Kensinger[1,2]; [1]Boston College, [2]Athinoula A. Martinos Center for Biomedial Imaging — People remember emotional stimuli with more subjective vividness than non emotional stimuli, but it is unclear how the factors of valence and delay affect the neural processes that correspond with this enhanced memory. In the present study, participants underwent an fMRI scan while they were shown high arousal pictures that were either positive or negative in valence and neutral pictures that were low in arousal. Immediately following the scan, and again approximately twenty-four hours later, participants were given a recognition memory test and a modified version of the Memory Characteristics Questionnaire. fMRI data was analyzed using an ANOVA, with the factors of memory accuracy (remembered, forgotten), valence (positive, negative), and retention delay (short, long) as factors. As expected, a main effect of memory accuracy was observed in key regions of the emotional memory network, including in the amygdala, hippocampus, and orbitofrontal cortex, with greater activity corresponding with subsequent memory. Although activity in this "core" network did not interact with valence, other regions did show an interaction between valence and memory accuracy. In particular memory for positive arousing information was associated with left lateralized activity, primarily in the frontal and parietal areas. On the other hand, memory for negative arousing information was primarily associated with enhanced activity in the extended amygdala. These findings suggest that valence can affect the processes that yield both short-term and longer-term retention of emotional memories.

F17

THE IMPACT OF TRANSFER-APPROPRIATE PROCESSING ON NEURAL CORRELATES OF ENCODING Eva M. Bauch[1], Leun J. Otten[1]; [1]Institute of Cognitive Neuroscience,University College London,UK — The principle of transfer-appropriate processing states that memory benefits from overlap between the processes engaged during encoding and retrieval. It is largely unknown how neural correlates of memory formation depend on how memory for an event is later probed. Here, we investigate the influence of study-test overlap on event-related potential (ERP) correlates of encoding by manipulating the congruency between the format of study and test items. In an incidental learning paradigm, electrical brain activity was recorded from the scalps of healthy adult volunteers while they made size judgments on intermixed series of pictures and words. After a one-hour delay, memory for the items was tested with a remember/know recognition test. Half of the studied items were cued in the alternative format (picture-word; word-picture) and half in the same format (word-word; picture-picture). For both words and pictures, study-test overlap affected ERP correlates of encoding. This was especially prevalent for studied pictures, which demonstrated a frontally-distributed effect when later cued with pictures, but a posteriorly- distributed effect when cued with words. These findings provide electrophysiological support that the neural correlates of encoding depend on both the type of stimulus material and the degree of overlap between study and test.

F18

TO INTENTIONALLY FORGET AN ITEM IS MORE EFFORTFUL THAN TO REMEMBER IT: AN ERP STUDY OF ITEM-METHOD DIRECTED FORGETTING Shih-kuen Cheng[1], I-Chun Liu[1], Daisy L. Hung[1], Ovid J-L. Tzeng[1,2], Jun Ren Lee[1,3]; [1]National Central University, Taiwan, [2]Academia Sinica, Taiwan, [3]National Taiwan Normal University, Taiwan — In this study we recorded ERPs while participants engaged in a procedure that combined semantic priming and item-method directed forgetting, aiming to investigate (1) whether intentional forgetting is more effortful than remembering, and (2) whether there are different kinds of semantic processing for to-be-remembered (TBR) and to-be-forgotten (TBF) items. Participants made lexical decisions to target words that were each preceded by a semantically related or unrelated prime word. A Remember/Forget cue, presented before the target, designated whether the preceding prime was TBR or TBF. Not surprisingly, a reliable directed forgetting effect for the primes was observed. More importantly, when the Remember/Forget cues were shown for 500 ms, the N170 and P200 waves were larger for targets preceded by Remember cues than those that were preceded by Forget cues. In addition, the topography of the N400 effect was different for targets preceded by Remember cues and those preceded by Forget cues. No reliable effects of Remember/Forget cues on the ERP waves were found when the cues were shown for 1500 ms. On the bases that the N170/ P200 waves are sensitive to attentional influence and the N400 effect reflects semantic processing, we conclude that forgetting demands more attentional resource than remembering and that the semantic processing was different for TBR and TBF items. Nevertheless, there is a temporal limitation for the modulations of Remember/ Forget cues on the semantic processing and attentional resources in the item-method directed forgetting

F19

FUNCTIONAL MAGNETIC RESONANCE (FMRI) CORRELATES OF RECOGNITION WITHOUT CUED RECALL Anthony J. Ryals[1], Felix M. Pichardo[2], Dan Lopez-Paniagua[1], Anne M. Cleary[1], Carol A. Seger[1]; [1]Colorado State University, Fort Collins, CO, [2]Purchase College--SUNY, Purchase, NY — Recollection-based recognition occurs when one recognizes something by recalling the instance in which it was experienced before. Familiarity-based recognition occurs when one recognizes something based only on a feeling or sense about the situation. Prior research has shown that damage to the hippocampus that spares perirhinal cortex results in impaired recollection but intact familiarity (Aggleton et al., 2005). Damage to perirhinal cortices that spares the hippocampus has been shown to preserve recollection but impair familiarity (Bowles et al., 2007). Our study examined the neural correlates of recollection and familiarity with a novel task. The Recognition without Cued Recall (RWCR) paradigm uses test cues that either do or do not resemble studied items, and separates recollection from familiarity based on whether cue recognition is accompanied by cued recall (Cleary, 2004). Cue recognition that is unaccompanied by successful cued recall is presumed to be familiarity-based. Our four participants showed the behavioral RWCR effect: They discriminated between test cues that resembled study items and test cues that did not in the absence of cued recall. For overall recognition, fMRI analyses revealed that cues resembling studied items elicited greater right hemisphere hippocampal activity than cues not resembling studied items, but no differences in parahippocampal activity. However, when we examined only cues for which cued recall was absent, a different pattern emerged: Cues that resembled studied items elicited greater bilateral parahippocampal (perirhinal and entorhinal) activity than cues that did not. Furthermore, hippocampal activity did not differentiate cues resembling studied words from cues not resembling studied words.

F20

THETA OSCILLATIONS IN TOP-DOWN CONTROL OF SOURCE MEMORY RETRIEVAL Erika Nyhus[1], Tim Curran[1]; [1]University of Colorado at Boulder — One of the major questions currently faced by cognitive neuroscientists is: How do the functionally specialized areas of the brain interact to perform rich cognitive abilities? Neural oscillations underlying the EEG signal can provide important information about local brain activity and the interaction among brain structures for the retrieval of episodic memories. It has been proposed that theta (~4-8 Hz) oscillations provide a general mechanism of top-down control in episodic memory (Kahana, Seelig, & Madsen, 2001; Klimesch, 1996, 1999; Klimesch, Freunberger, Sauseng, & Gruber, 2008). The present study examined theta power and long-range theta synchronization between frontal and posterior regions during source retrieval. Subjects studied adjectives and either imagined a scene (Place Task) or imagined what the word would sound like read backwards (Read Task). During the recognition test subjects judged which task the word was studied in ("Old Place Task" or "Old Read Task") or "New". Subjects' discrimination of old and new words was greater for the Place than the Read task and discrimination of source was above chance. Theta effects were greatest from 500-800 ms over right frontal and left parietal channels. From 500-800 ms, theta power over right frontal and left parietal channels and frontal-parietal coherence was greater for correct and incorrect source judgments than new judgments. These results indicate that right frontal theta is engaged for source retrieval and that frontal-parietal theta synchronization could represent top-down control from frontal to posterior regions to retrieve source information.

F21

RELATIONSHIPS BETWEEN WHITE MATTER INTEGRITY AND TWO FORMS OF RECALL IN HEALTHY AGING Kristin M. Thomas[1], Ilana J. Bennett[1], David J. Madden[2], Chandan J. Vaidya[1,3], James H. Howard, Jr.[1,4], Darlene V. Howard[1]; [1]Georgetown University, [2]Duke University Medical Center, [3]Children's National Medical Center, [4]Catholic University of America — Some forms of memory decline with healthy aging, possibly resulting from age-related differences in white matter integrity. We used diffusion tensor imaging (DTI) tractography to measure integrity of bilateral hippocampus-prefrontal tracts relevant to recall memory performance. We also assessed two corpus callosum tracts (genu and splenium) that enable interhemispheric communication and likely influence more general cognitive function, including processing speed. Tract integrity, measured as fractional anisotropy (FA), was compared in younger (n=14; 18.9 ± 0.7 years, 9 female) and healthy older (n=14; 67.6 ± 3.1 years, 10 female) adults. We also examined relationships between FA and performance on two measures of recall memory: incidental recall (Digit-Symbol pairing) and intentional recall (USC-REMT list recall). Results revealed that older adults recalled less than younger adults on both tasks. Age-related differences in FA were largest in the genu, moderate in the splenium, and non-significant in the hippocampus-prefrontal tracts. Independently of age group, both incidental and intentional recall performance was related to higher FA in genu and splenium tracts, with intentional recall also relating to higher FA in the right hippocampus-prefrontal tract. In addition, stepwise regression revealed that genu FA was a marginally significant mediator of age-related differences in intentional recall. Thus, both intentional and incidental recall may depend on integrity of tracts involved in more general processes (genu, splenium), whereas intentional, but not incidental, recall may also rely on integrity of more memory-specific hippocampal tracts. Furthermore, individual differences in the integrity of the genu may contribute to age-related differences in intentional recall.

F22

PREPARATORY NEURAL ACTIVITY PREDICTS PRIMACY: THE ROLE OF SEMANTIC PREPARATION IN LIST LEARNING Giulia Galli[1], Leun J. Otten; [1]Institute of Cognitive Neuroscience, University College London — Neural activity immediately before an event can predict whether the event will later be remembered or forgotten. This suggests that memory formation is influenced by preparatory mechanisms engaged ahead of stimulus presentation. Here, we asked whether preparatory activity affects the learning of short word lists, and whether such activity varies as a function of serial position within the list. Healthy young adults studied lists of randomly intermixed visual and auditory words. Each word was preceded by a cue, which indicated the modality of the upcoming word. Lists were memorized with either an elaborative or rote rehearsal strategy. At the end of each list, volunteers performed a brief distraction task before being probed for free recall. As expected, recall performance was better for the first few words in a list and following elaborate rehearsal. Crucially, electrical brain activity before a word predicted subsequent recall of the word, but only for the first few items in a list. This effect was most pronounced for auditory words and with elaborative rehearsal. In contrast, word-elicited activity did not differ depending on serial position or rehearsal strategy. These findings demonstrate that preparatory activity plays a role in list learning. The specificity of such activity to the elaborative rehearsal condition suggests that semantic processes contribute to the effect. Importantly, preparatory activity only affected later recall of items in the first list positions. This challenges the notion that item-induced rehearsal is the main determinant of serial position effects.

F23

METAMEMORY JUDGMENTS OF EPISODIC AND SEMANTIC MEMORY: AN FMRI STUDY Niv Reggev[1], Maya Zuckerman[1], Anat Maril[1]; [1]The Hebrew University of Jerusalem — Metamemory refers to monitoring and control of one's memory performance. One measure of metamemory is the feeling of knowing (FOK). Theoretical accounts of FOK postulate the cue-familiarity and the accessibility heuristics in generating FOKs. Interestingly, no theoretical consideration of possible differences between the monitoring of episodic and of semantic knowledge has been put forward thus far. At the same time, evidence from patients and drugs studies find selective impairment in episodic FOKs but not in semantic ones, suggesting that metamemory monitoring might be different between these two types of memory. Similarly, neuroimaging studies reveal different patterns of activation during episodic or semantic FOKs. However, as these studies employed a variety of stimuli in a variety of experimental paradigms, the comparison between episodic and semantic monitoring is impossible, as this factor cannot be isolated from other design elements. In the current event-related fMRI study, we used a within-participant, within-experiment comparison of both types of monitoring. Prior to scanning, participants studied cue-target pairs. They later made FOK judgments for the studied items and for general knowledge questions while scanned. The to-be-retrieved items were used as targets in the episodic task for half of the participants, and as answers for the semantic questions for the other half, counterbalanced between participants. While the separate neural correlates of episodic and semantic FOKs found in this study generally replicate previous neuroimaging findings in medial and lateral frontal regions, the comparison between them reveals significant differences, suggesting that distinct cognitive elements or computations operate in these tasks.

F24

DOPAMINE AND EPISODIC MEMORY: WOMEN'S FACE RECOGNITION PERFORMANCE IS RELATED TO D1 BINDING POTENTIAL IN FUSIFORM GYRUS Johanna Lovén[1], Sari Karlsson[1], Yvonne Brehmer[1], Anna Rieckmann[1], Per Karlsson[1], Lars Farde[1], Agneta Herlitz[1], Lars Bäckman[1]; [1]Karolinska Institutet — Human and animal data indicate that dopamine (DA) is related to cognitive performance, although the extent to which the DA-cognition link differs between men and women remains unclear. In a pharmacological study, we assessed the relation between D1 binding potential (BP) and face recognition performance in 20 young adults (10 women, 10 men). Participants studied faces in baseline and D1 antagonist conditions for later recognition. Before face encoding, they were injected with a placebo drug or with 0.5 mg of the SCH23390 antagonist. Memory for faces was generally lower in the antagonist compared to the baseline condition. However, closer inspection of the data showed that the D1 antagonist affected women's, but not men's performance. Critically, women's D1 BP in fusiform gyrus was related to baseline memory performance, such that higher BP was associated with better face recognition. Further, women with higher BP were more affected by the antagonist than women with lower BP. This is the first evidence of a link between D1 BP in a brain area selectively involved in face perception and memory. In addition, the present results suggest that there are differences in how DA regulates cognitive functioning in women and men.

F25

TRUE AND FALSE RECOLLECTION ACTIVATES VENTRAL PARIETAL CORTEX Pamela LaMontagne[1], Jian Zhu[1], Reza Habib[1]; [1]Southern Illinois University, Carbondale — Theories regarding the ventral parietal cortex (VPC) during episodic memory retrieval include the attention to memory (AtoM) and the episodic buffer hypotheses. AtoM proposes that salient (recollected) memories involve bottom-up attention and VPC activity. The episodic buffer hypothesizes that VPC activity is related to the amount of information retrieved from long-term storage into a temporary buffer for use with working memory. We examined the role of the VPC by manipulating the veracity of items and amount of information encoded. On day one, subjects studied picture-word associations one, three and seven times. For the final presentation on day two, half of the repeated trials replaced the word associated with each picture with a new word at the time of scanning, resulting in intact and recombined pairs. At retrieval, subjects made Remember/Know/New recognition decisions indicating whether they could recall details from items presented on day one, if they simply knew the pair was from day one, or whether the item was newly presented on day 2. Left temporal-parietal junction and bilateral hippocampus activity was greater for Remember than Know responses for intact (true recollection), recombined (false recollection), and new picture-word pairs (false recollection). Greater activity for Know than Remember responses was observed in left intraparietal sulcus for intact and recombined pairs. Consistent with AtoM and lesion studies, subjective recollection of true and false memories involved activity in the VPC. VPC activity during false recollection is incompatible with the episodic buffer hypothesis since no information is actually retrieved from long-term storage.

F26

DOMAIN SPECIFICITY IN MEDIAL TEMPORAL LOBE CORTEX DURING EPISODIC MEMORY FORMATION Bernhard Staresina[1], Katherine Duncan[1], Lila Davachi[1]; [1]New York University — Although the key role of the medial temporal lobe (MTL) in memory formation is well established, the division of labor among different MTL subregions remains poorly understood. In this fMRI study, we assessed whether the contributions of the perirhinal cortex (PrC) and parahippocampal cortex (PhC) are domain-specific, differentially supporting successful encoding of object- vs. scene-related source information (Davachi, 2006). To this end, participants were presented with adjectives during encoding and instructed to imagine either an object or a scene described by the adjective. Imagery success was assessed via subjective ratings of the vividness/resolution of the resulting mental image. During the post-scan retrieval test, participants first indicated whether they recognized a given adjective and if yes, whether they had imagined an object or a scene described by that adjective. Results from 14 participants so far reveal that, behaviorally, imagery ratings and source memory were equated across object and scene trials. Critically, however, we found evidence for the differential engagement of PrC and PhC during successful source encoding as a function of the to-be-imagined stimulus domain. While successful source encoding during object trials was accompanied by enhanced PrC activation, PhC showed enhanced activation during successful source encoding of scene trials. These data suggest that the functional involvement of different MTL subregions is modulated by the domain of internally-activated representations during encoding.

F27

HIGH-RESOLUTION FMRI OF RELATIONAL PATTERN SEPARATION IN THE HUMAN MEDIAL TEMPORAL LOBE Valerie A. Carr[1], Serra E. Favila[1], Anthony D. Wagner[1]; [1]Stanford University — In forming new memories, the hippocampus is thought to separate related input patterns into distinct representations, thereby minimizing interference between similar memory traces. Recent fMRI findings in humans suggest differing biases among hippocampal subfields toward pattern separation in response to manipulations of item similarity. Given the central role of the hippocampus in relational memory, the current study aimed to evaluate medial temporal lobe (MTL) responses to manipulation of the spatial relationships among items. To this end, we scanned participants using high-resolution fMRI and a rapid adaptation paradigm in which trials began with presentation of a unique scene, followed by a scene in which: all items remained in the same location (identical), one pair of items swapped location (one-swap), two pairs of items swapped locations (two-swap), all items moved to novel locations (scramble), or new items were placed in novel locations (new). We hypothesized that (a) the identical condition would lead to adaptation of BOLD signal across all MTL subfields, and (b) critically, different levels of adaptation would appear across subfields in response to changes in relational similarity, with some subfields showing a linear release from adaptation and others showing an exponential release. Examination of BOLD activity extracted from anatomically defined regions of interest in both the hippocampus (CA1, CA3/dentate, and subiculum) and surrounding MTL cortices (parahippocampal, perirhinal, and entorhinal) revealed both response patterns. These findings further advance mechanistic accounts of MTL function, and help bridge human imaging findings with predictions from neural-network models and observations in rodents. Funding: NIMH(5RO1-MH076932), NARSAD

F28

SELF-REFERENCE AND RELIVING DURING AUTOBIOGRAPHICAL MEMORY RETRIEVAL ARE LINKED TO DISSOCIABLE VENTRAL VS. DORSAL MIDLINE REGIONS: AN FMRI STUDY USING A NOVEL CAMERA TECHNOLOGY Peggy L. St. Jacques[1], Martin A. Conway[2], Matthew W. Lowder[1], Roberto Cabeza[1]; [1]Duke University, Durham, NC, [2]University of Leeds, Leeds, UK — Self-reference and reliving are critical components of autobiographical memory (AM) which allow us to re-experience our personal past. We used a novel camera technology, which employs a sensor and timer to automatically take hundreds of photographs when worn, in order to elicit AMs using dynamic visuospatial images and to literally ask participants to take a self vs. other perspective. Using functional MRI (fMRI) we examined the neural correlates associated with: 1) Self-Reference, by comparing AMs elicited from a self-perspective vs. understanding of another person's perspective, and 2) Reliving, by comparing AMs elicited by visuospatial vs. verbal cues. Across both manipulations, we found a dorsal vs. ventral distinction in cortical midline regions. First, in the self-referential manipulation we found that AMs recruited greater ventral medial PFC (mPFC), whereas understanding another perspective recruited dorsal mPFC. Moreover, task-related functional connectivity analysis revealed that ventral mPFC contributed to the medial temporal lobe network linked to memory, whereas dorsal mPFC contributed to the frontoparietal network linked to controlled processes. Second, in the reliving manipulation, AMs retrieved via visuospatial cues recruited greater retrosplenial cortex, whereas AMs retrieved via verbal cues recruited greater posterior cingulate. Additionally, retrosplenial cortex had greater functional connectivity to bilateral visual cortices and precuneus linked to visual imagery, whereas posterior cingulate had greater functional connectivity to PFC and temporal regions associated with controlled semantic processing. In sum, these results suggest that subregions of the posterior and anterior midline are functionally dissociable and may differentially contribute to self-reference and reliving during AM retrieval.

F29

NEURAL CORRELATES OF THE RETRIEVAL OF TEMPORAL ASSOCIATIONS Maki Suzuki[1], Michael D. Rugg[1]; [1]University of California, Irvine — It is well established that the hippocampus, along with adjacent regions of the medial temporal lobe (MTL), supports memory for item-item associations. It has been proposed that the hippocampus is also crucial for memory for temporal associations between items. Here, we used functional magnetic resonance imaging (fMRI) to investigate whether the same or different brain regions are activated during successful retrieval of associative and temporal information. On each of a series of study trials, subjects were presented with two words in succession (1500 ms presentation duration, 1000 ms inter-stimulus interval) with the requirement to judge which item fit inside the other. Subjects were then given a scanned surprise memory test. Test items comprised a mixture of intact pairs (words in the same pairing as at study), rearranged pairs (words drawn from different study pairs), and new pairs. The task was to make one of four judgments to each test pair: intact/top (top word was presented first at study), intact/bottom (bottom word was presented first at study), rearranged, or new. The only region to be activated both by successful associative and successful temporal memory was the precuneus. Retrieval effects unique to associative memory were evident in numerous regions, including bilateral lateral parietal and left parahippocampal cortex. Successful retrieval of temporal information was associated with activation in the left anterior MTL on the border of the amygdala and hippocampus. These findings suggest that the neural correlates of the retrieval of associative and temporal information are largely independent.

F30

RELEVANCE MODULATES ACTIVATION OF PARIETAL CORTEX IN RESPONSE TO MNEMONIC STATUS Jeremy A. Elman[1], Arthur P. Shimamura[1]; [1]University of California Berkeley — The posterior parietal cortex (PPC) shows consistent activation during memory tasks; however, its specific function is still unknown. Previous studies have found the PPC to show greater activation for items recognized as old compared to new items, termed the 'parietal old/new effect.' This is especially apparent in the ventral PPC as strength of activation tends to increase with the amount of information retrieved. It remains unclear to what extent this activity is regulated by automatic bottom-up processing versus goal-related top-down control. Here, we investigate whether activation in the ventral PPC shows similar patterns of activation in response to new and old items when they are encountered in both memory and non-memory tasks. Subjects completed an explicit recognition task and a lexical decision task in which the mnemonic status of targets held different degrees of relevance to the task goal. The parietal old/new effect was present in each task, but the strength of activation in both parietal cortex and frontal areas was modulated by the relevance of recognizing old items to successful task completion. This suggests that memory related activity in the ventral PPC is subject to top-down control.

F31

CHANGE DETECTION IN VISUAL SEARCH REVEALS DECLARATIVE/ RELATIONAL MEMORY ACROSS SPECIES Vivian L. Chau[1], Emily F. Murphy[1], R. Shayna Rosenbaum[1,2], Jennifer D. Ryan[2,3], Kari L. Hoffman[1]; [1]York University, [2]Rotman Research Institute of Baycrest, [3]University of Toronto — Search patterns when viewing repeated stimuli have been used to assay memory, though the effects typically span delays of only seconds to hours of the original stimulus presentation. Here, we used flicker change detection in a repeated-trial design to address whether 1. change detection time could be used as a measure of declarative/relational recall of long-term memories, 2. the detection time for an anterograde amnesic would show repetition effects, and 3. monkeys show repetition effects like those seen in humans. In Experiment 1, nine healthy adults searched for the changing object embedded in a flickering natural scene as their eye movements were recorded. Verbal reports of memory for the object corresponded to faster change detection times (remembered < forgotten, p<10^-12), regardless of delay interval (1 or 28 days). This led to an overall difference between detection times for novel and repeated images (repeated < novel, p<10^-4). In Experiment 2, we tested a patient with bilateral hippocampal damage (D.A.) using the same experimental design. Unlike our age-matched controls, D.A. reported no memory for the objects; moreover, his detection times overlapped those observed for novel trials (repeated < novel: controls, p<10^-4; D.A., p=0.66), suggesting that rapid detection time indicates remembered objects. In Experiment 3, we tested a rhesus macaque and, parallel to healthy human participants, a rapid 'mode' of detection times was seen for repeated images compared to novel images (repeated < novel, p<10^-3). Taken together, our results suggest that change detection time could be used as a measure of declarative/relational memory.

F32

LEARNING EXCEPTIONS TO THE RULE: HIGH-RESOLUTION FMRI OF HIPPOCAMPAL SUBFIELD CONTRIBUTIONS TO CATEGORY LEARNING Tyler Davis[1], Bradley C. Love[1], Alison R. Preston[1,2]; [1]The University of Texas at Austin, Austin, TX, [2]Center for Learning and Memory, The University of Texas at Austin, Austin, TX — The medial temporal lobe (MTL) and its connections with midbrain, prefrontal cortex (PFC), and striatum have been implicated in different forms of novelty processing. In the present study, we examine a unique novelty detection task where subjects learn categories containing items that violate a salient regularity. These "exceptions to the rule" are novel in the context of their categories because they share critical features with an opposing category, and must be learned and stored separately to enable correct categorization. Previous theoretical (Love & Gureckis, 2007) and whole-brain fMRI (Davis, Love, & Preston, submitted) research suggests that the hippocampus is engaged during exception learning and is modulated by midbrain, PFC, and striatum. The current study employs high-resolution fMRI techniques to investigate the role of hippocampal subfields in exception learning. High-resolution methods extend our previous whole-brain results by allowing us to dissociate the function of individual hippocampal subfields and MTL cortical regions. Within the MTL, our results reveal that CA1 and a combined region of CA2,3 and dentate gyrus are recruited during categorization of exception items as well as in response to categorization errors. Such findings are consistent with theories suggesting that the hippocampal circuit acts as a comparator to evaluate incoming information by comparing it with previously stored representations and forming new representations in response to prediction error. Specifically, we suggest that the CA fields and dentate gyrus are recruited both to encode new representations when exceptions are first encountered and to retrieve these representations when needed for accurate exception performance.

F33

THE IMPACT OF APPROACH AND AVOIDANCE MOTIVATION ON SPATIAL LEARNING IN HUMANS Vishnu Murty[1], Kevin LaBar[1], Courtnea Rainey[1], Derek Hamilton[2], R. Alison Adcock[1]; [1]Duke University, [2]The University of New Mexico — Affective motivation has been demonstrated to modulate hippocampally-dependent spatial learning in rodents, but relatively little research has investigated these processes in humans. The current study investigates the impact of avoidance and approach motivation on spatial learning in a modified Virtual Reality-version of the Morris water maze task. Forty participants performed a spatial learning task in a VR water maze with both correct and incorrect hidden platforms. During this task, participants were instructed to navigate towards correct platforms while avoiding incorrect platforms. Learning occurred over multiple trials in unique environments. Half of the participants received shocks for navigating to incorrect platforms (or letting trial time expire) to elicit avoidance motivation, while the other half received monetary rewards for navigating to correct platforms to elicit approach motivation. During learning, avoidance motivation disrupted and approach motivation enhanced spatial learning in multiple independent assays of spatial memory. Participants found more correct platforms in the approach compared to avoidance condition. On correct trials, participants had shorter path lengths to correct platforms in the approach compared to avoidance motivation conditions. On probe trials, participants in the approach condition demonstrated better spatial localization of both platforms than participants in the avoidance condition. Finally acquisition of learning across trials was faster under approach compared to avoidance motivation. These findings not only demonstrate the utility of this novel translational method for investigating spatial learning in humans, but also the unique roles of approach and avoidance motivation on spatial learning.

F34

POSTERIOR PARIETAL LESIONS IMPAIR MULTIMODAL BUT NOT UNIMODAL PAIR-ASSOCIATE LEARNING Daniel A. Levy[1]; [1]The Interdisciplinary Center, Herzliya, Israel — The involvement of posterior parietal cortex (PPC) in long-term declarative memory retrieval poses a puzzle for cognitive neuroscience. On one hand, electrophysiological and hemodynamic studies of memory have consistently noted robust lateral PPC activation during memory retrieval, especially accompanying detailed recollection of studied materials and their contexts. On the other hand, neuropsychological studies have revealed few substantive deficits in long-term mnemonic abilities in the wake of lateral parietal lesions, with recognition memory specifically found to be intact. We hypothesized that parietal processes might be of greater importance for certain more demanding forms of retrieval. Accordingly, we compared pair-associate learning curves for cued recall of unimodal-verbal and multimodal (picture-sound) learning in stroke patients whose unilateral damage includes PPC. Several patients exhibited a notable dissociation of preserved unimodal and very impaired multimodal cued recall. The deficits were found despite intact initial processing of the multimodal stimuli. It is hypothesized that parietal contributions to retrieval may include multi-modal sensory integration that is attributed to PPC in its role as a cortical association area.

F35

DISSOCIATING RECOLLECTION AND FAMILIARITY WITH RESPONSE BIAS: EVIDENCE FROM YOUNG ADULTS, OLDER ADULTS, AND PATIENTS WITH ALZHEIMER'S DISEASE Rebecca G. Deason[1,2], Erin P. Hussey[1,2], Brandon A. Ally[1,2], Andrew E. Budson[1,2]; [1]Center for Translational Cognitive Neuroscience, Bedford VA Hospital, MA, [2]Boston University — Do recollection and familiarity rely upon different processes? As a result of their impaired recollection, AD patients rely more on familiarity. This reliance on familiarity may contribute to the abnormally liberal response bias (greater tendency to respond "old") also seen in AD patients. In this experiment, we examined whether increasing reliance on familiarity over recollection would also lead to a liberal response bias in younger and older adults, potentially indicating that familiarity and recollection have different response biases. To increase reliance on familiarity, we used differing delays between study and test phases, as longer delays are thought to reduce the contribution of recollection more than familiarity. Younger adults, older adults, and AD patients were run in two study-test sessions, with study and recognition test phases separated by either a one-minute or one-day delay. With the one-minute delay, both younger adults and healthy older adults showed a conservative response bias, while AD patients showed a liberal response bias. But at the one-day delay, the younger and older adults showed a liberal response bias similar to the AD patients. The one-day delay reduces recollection and thus memorial judgments in this test phase are based primarily on familiarity leading younger and older adults to shift to a more liberal response bias. AD patients rely mainly on familiarity, regardless of the delay, due to their impaired recollection and they consistently show a liberal response bias. A liberal response bias may reflect increased reliance upon familiarity.

F36

PUTTING CONTEXT IN CONTEXT: THE MNEMONIC ROLE OF THE PARAHIPPOCAMPAL CORTEX IN CONTEXTUAL PROCESSING Talya Sadeh[1], Anat Maril[2], Yonatan Goshen-Gottstein[1]; [1]Tel-Aviv University, [2]The Hebrew University of Jerusalem — A key feature of episodic memory is the binding of an event to the context in which it occurred. Recent studies implicate the parahippocampal cortex (PHc) in the processing of context. These studies have typically used a definition of context which operationalizes it as a dichotomous, external entity. However, theoretical models of episodic memory have demonstrated that context must be viewed in a more expansive manner, with context being conceptualized as a continuously fluctuating internal mental state. The goal of our research was to examine whether the PHc represents context in this more expansive interpretation. To this end, we used an approach informed by cognitive models which establish that—as compared to recall—recognition relies more heavily on the processing of a continuously fluctuating internal context at encoding. We therefore predicted that activity in the PHc would be found when contrasting neural activity during encoding of items subsequently remembered in a recognition test with encoding activity of items subsequently remembered in a recall test. To test this hypothesis, we used fMRI to measure participants' neural activity while they incidentally studied cue-target pairs. Each pair was subsequently submitted to either a multiple choice recognition test or to a recall test. As predicted, activity in the PHc was found when contrasting neural activity during encoding of items subsequently remembered in the recognition test with encoding activity of items subsequently remembered in the recall test. These results provide evidence for the role of the PHc in episodic encoding of continuously fluctuating internal context.

F37

EFFECTS OF EARLY THYROID HORMONE DEFICIENCY ON CHILDREN'S AUTOBIOGRAPHICAL MEMORY PERFORMANCE AND HIPPOCAMPAL MORPHOMETRY Karen Willoughby[1,2], Jovanka Skocic[2], Joanne Rovet[1,2]; [1]University of Toronto, [2]Hospital for Sick Children — Animal research has shown that the hippocampus, a critical structure for autobiographical memory (AM), is particularly vulnerable to thyroid hormone (TH) deficiency. Hippocampal abnormalities, as well as memory and learning and visuospatial impairments have also been found in children who, due to maternal hypothyroidism (HYPO) or congenital hypothyroidism (CH), received insufficient levels of TH during gestation. However, no study to date has investigated AM performance in these clinical populations. Thus, the purpose of the present study was to examine whether TH-deficient children show deficits in AM recall relative to controls, and whether their deficits are associated with abnormalities in hippocampal structure. Participants were 60 children between 10-14 years of age (M=10.66; 31 males), including 18 HYPO, 18 CH, and 24 controls. Using the Children's Autobiographical Interview, participants recalled two autobiographical events and answered a series of structured questions to elicit additional episodic details. Interviews were scored using a standardized system that provided total AM recall scores, as well as scores for five subcategories of episodic details. After controlling for age and gender using MANCOVA, significant group differences were found for total AM details ($p<.001$), as well as event ($p<.001$), time ($p<.05$), and perceptual ($p<.001$) details, with controls recalling more details than the TH-deficient group. While groups did not differ significantly in hippocampal volume, AM recall was significantly correlated with hippocampal volume in controls, but not in the TH-deficient group. Overall, the results suggest that abnormal hippocampal development due to early TH deficiency appears to have long-term effects on children's AM.

F38

COMMON BRAIN REGIONS ASSOCIATED WITH RETRIEVAL OF SPATIAL RELATIONS IN EPISODIC & SEMANTIC MEMORY Siobhan Hoscheidt[1], Lee Ryan[1], Lynn Nadel[1]; [1]University of Arizona — Traditionally, episodic memory and semantic knowledge have been viewed as very different types of memory, dependent on different brain region. However, recent research has argued that episodic memory and semantic knowledge may elicit common regions of activation, depending on the type of information being retrieved (Ryan et al, 2009), specifically spatial information. To test this hypothesis we experimentally varied spatial retrieval in an episodic and semantic memory task, asking participants to retrieval spatial relations and spatial locations within each memory condition. We then compared patterns of whole-brain activation across memory type. Subjects (N=18), aged 20-30, recalled 30 autobiographical events during an interview. A week later, during an fMRI scan, participants answered "True/False" questions regarding spatial relations and spatial locations within autobiographies and world knowledge. Images were collected on a General Electric 3T. Data were analyzed using SPM-5. Results reveal that retrieval of spatial relations within semantic memory elicits similar brain regions as the retrieval of episodic memory, overall. By contrast, retrieval of spatial locations in semantic knowledge elicited activation in bilateral lingual gyrus, only. Regions of activation across episodic spatial tasks showed significant overlap, with the exception of basal ganglia regions that showed preferential activation for spatial location. Data provide evidence that episodic and semantic memory depend on similar regions based on the type of information being retrieved. This is particularly true for the retrieval of spatial relations, which showed a distinct pattern of whole-brain activation, regardless of whether recalling spatial relations from past experienced events or world knowledge.

F39

EMG AND FMRI EVIDENCE FOR RESPONSE CONFLICT IN THE EXCLUDE-RECOGNITION TASK Hillary Schwarb[1], Travis L. Seymour[2], Eric H. Schumacher[1]; [1]Georgia Institute of Technology, [2]University of California, Santa Cruz — Although we may often recognize many stimuli in our environments, it is not always appropriate to acknowledge this recognition. What happens then when we recognize information we do not wish to acknowledge? How do memory retrieval processes (i.e., familiarity and recollection) interact with motor and control processes to bring about an appropriate response? How do we control the interaction between familiarity and recollective processes to produce recognition responses appropriate to our current task goals? The parallel task-set model (Seymour, 2001) predicts that under some circumstances familiarity and recollection processes activate competing responses. These predictions as well as those of the conflict monitoring hypothesis (e.g., Botvinick et al. 2001) suggest that competition should lead to response conflict. In two experiments, we investigated the influences of familiarity and recollection and the role of response conflict in the exclude-recognition task using electromyographic (EMG) and functional magnetic resonance imaging (fMRI). In Experiment 1, participants performed the exclude-recognition task (words) while surface EMG was measured on the triceps. On probe trials (where participants were instructed to respond "new" to previously viewed stimuli), subthreshold EMG associated with the incorrect "old" response reliably preceded superthreshold EMG associated with task-appropriate "new" correct response. These partial-errors provide strong evidence for response conflict in the exclude-recognition task. In experiment 2, participants performed the exclude-recognition task (faces) while undergoing fMRI. They demonstrated anterior cingulate cortex activity on probe trials again indicative of response conflict. Together these data provide substantial support for the hypothesis that the exclude-recognition task involves response conflict.

F40

THE HIPPOCAMPUS IS COUPLED WITH THE DEFAULT NETWORK DURING MEMORY RETRIEVAL BUT NOT DURING MEMORY ENCODING Willem Huijbers[1], Cyriel Pennartz[1], Roberto Cabeza[2], Sander Daselaar[1]; [1]University of Amsterdam, [2]Duke University — The brain's default mode network (DMN) is activated during internally-oriented tasks and shows strong coherence in spontaneous rest activity. Despite a surge of recent interest, the functional role of the DMN remains poorly understood. Interestingly, the DMN activates during retrieval of past events but deactivates during encoding of novel events into memory. One hypothesis is that these opposing effects reflect a difference between attentional orienting towards internal events, such as retrieved memories, vs. external events, such as to-be-encoded stimuli. Another hypothesis is that hippocampal regions are coupled with the DMN during retrieval, but decoupled from the DMN during encoding. The present fMRI study investigated these hypotheses by combining a resting-state coherence analysis with a task that measured encoding and retrieval of both externally-presented events and internal events that were generated through mental imagery. Increased hippocampal activity was associated with successful encoding of both internal and external events as well as with successful retrieval of internal and external events. Moreover, a task-based coherence analysis indicated that hippocampus was decoupled from the DMN during encoding but not during retrieval. These results support the hippocampal-coupling hypothesis rather the internal orienting account. They also indicate that the hippocampus is not one of the "core" DMN regions. Taken together, our findings clarify the relationship between the DMN and the neural correlates of memory retrieval and encoding.

F41

MEMORY FOR NON-MONITORED BACKGROUND: AN FMRI STUDY Yaakov Hoffman[1], Anat Maril[1]; [1]The Hebrew University of Jerusalem — When monitored stimuli appear in context, the question arises as to whether a non-monitored study context is represented in a retrievable memory trace. In Experiment 1, stimuli consisted of a smaller black word printed on a larger grey word. Participants made a vowel judgment on the black monitored word. Memory for the non-monitored grey word was assessed by a typical context paradigm recognition test which included four types of stimuli; Target-old-Background-old (ToBo), Target- old-Background-new (ToBn), Target-new-Background-old (TnBo) and Target-new–Background-new (TnBn). Memory for the background was found under both Target conditions, old (ToBo-ToBn) and new (TnBo-TnBn).The small but reliable effect indicating that non-monitored elements are encoded and remembered, contrasts with earlier theories concerning memory of non-monitored study material. Behavioral results may underestimate this effect, as background may be suppressed by the target. To address this issue we ran an event-related fMRI experiment (current N=7), where subjects were scanned at the recognition test stage. Results revealed activation in anterior cingulate- and dorsolateral prefrontal cortex for TnBo>TnBn, indicating a conflict, which in turn indicates robust memory for background: had the background not been remembered there would be no conflict. These regions were not observed for ToBn>ToBo - while it is likely that the background was remembered to the same extent in the target old condition, manifestation of conflict may only be possible in the absence of an old target, which, when present, dominates the recognition decision process. Results suggest that in different target conditions, recognition of background is based on different processes.

Perception & Action: Motor Control

F42

ALTERED RESTING-STATE EFFECTIVE CONNECTIVITY OF THE FRONTO-PARIETAL CIRCUIT ON THE PRIMARY MOTOR NETWORK FOLLOWING STROKE Cory S. Inman[1], G. Andrew James[1,2], Justin Rajendra[1], Stephan Hamann[1], Giuseppe Pagnoni[1,3], Andrew J. Butler[1]; [1]Emory University, [2]University of Arkansas, [3]University of Modena and Reggio Emilia — Previous studies have found that stroke alters the effective connectivity of motor execution networks. Here we examined the intrinsic effective connectivity of top-down motor control in stroke survivors relative to healthy participants. Stroke survivors demonstrated significant deficits in motor function, as measured by a standard evaluative instrument for measuring sensorimotor stroke recovery (Fugl-Meyer). The relationship between these observed deficits in motor function and intrinsic effective connectivity between brain regions involved in motor control and motor execution were investigated with structural equation modeling (SEM) of resting-state fMRI data (rs-fMRI). After generating a model that fit healthy controls well, we applied the control model to the stroke survivors data. We observed alterations in spontaneous effective connectivity from the fronto-parietal circuit to the resting-state motor network in stroke survivors, particularly in connections from the superior parietal cortex (PAR) to primary motor cortex (M1) and supplementary motor cortex (SMA). Furthermore, in stroke survivors, but not in healthy participants, these particular paths were characterized by large individual variance in their strength of influence upon each other. Importantly, previous studies have suggested that the fronto-parietal network exerts control over primary motor systems to guide upper-limb reaching behaviors. The present study is the first to highlight the importance of the PAR to M1 and PAR to SMA paths in healthy motor function using rs-fMRI. These findings suggest that illustrating the resting-state connectivity deficits in top-down control of motor performance, will help therapist target neural networks that should be reestablished by cognitive and physical stroke rehabilitation treatments.

F43

MUSICIAN SEE, MUSICIAN DO: MUSICAL EXPERIENCE INFLUENCES GESTURE IMITATION Michael Spilka[1,2], Christopher J. Steele[1], Virginia B. Penhune[1,2]; [1]Concordia University, [2]International Laboratory for Brain, Music, and Sound Research (BRAMS) — Imitation plays a crucial role in the learning of many complex motor skills. Recent behavioural and neurophysiological evidence suggests that the ability to imitate is influenced by past experience, such as musical training. To investigate the impact of musical training on motor imitation, musicians and non-musicians were tested on their ability to imitate videoclips of simple and complex two-handed gestures taken from American Sign Language. Participants viewed a set of 30 gestures, one at a time, and imitated them immediately after presentation. Participants' imitations were videotaped and scored off-line by raters blind to participant group. Imitation performance was assessed by a rating of performance accuracy, where the arm, hand, and finger components of the gestures were rated separately on a 5-point scale (1=unrecognizable; 5=exact imitation). A global accuracy score (PAglobal) was calculated by summing the three scales. Response duration compared to the model (%MTdiff), and reaction time (RT) were also assessed. Results indicated that musicians were able to imitate more accurately than non-musicians, reflected by significantly higher PAglobal and %MTdiff scores. Furthermore, the greatest difference in performance was for the fine-motor gesture component (finger). These findings support the view that the ability to imitate is influenced by experience. This is consistent with generalist theories of motor imitation, which explain imitation in terms of links between perceptual and motor action-representations that become strengthened through experience. It is also likely that musical training contributed to the ability to imitate manual gestures by influencing the personal action repertoire of musicians.

F44

FROM ACTION EXPERTISE TO SHARED ACTION PLANS: INCLUSION OF NON-CONTROLLED ACTIONS AT THE INTRA- AND INTER-PERSONAL LEVEL Jessica Chia-Chin Tsai[1,2], Günther Knoblich[1,2], Natalie Sebanz[1,2]; [1]Donders Centre for Cognition, Radboud University Nijmegen, The Netherlands, [2]The Social Mind and Body Group (SOMBY), Radboud University Nijmegen, The Netherlands — The aim of the present electrophysiological study was to determine whether incoporating an observed action into one's action plan depends on how well the observed action matches one's motor expertise, and whether it depends on the observed action being performed by an intentional agent. Participants responded to one of two color targets appearing at ipisilateral (compatible) and contralateral (incompatible) sites. Below the stimuli, pictures of chopsticks and a spoon were arranged in a congruent (spoon left) or incongruent (spoon right) way with Asian participants' dining habits. Participants experienced control over the cutlery on the right side –it moved whenever they responded to targets. When alternative color targets appeared, participants saw the other piece of cutlery move, either by itself (solo condition) or as a consequence of a confederate's key press (joint condition). When acting alone, a larger compatibility effect was found when the cutlery was arranged congruently with participants' dining habits. This can be explained by the match of the observed actions with one's motor expertise. This compatibility effect was correlated with the ERP-N2 amplitude that reflects response selection conflict. The effect of motor expertise was eliminated in the joint condition, where the compatibility effects in RTs and ERP-N2 amplitudes were identical regardless of congruency of the cutlery arrangement. In addition, larger P3 amplitudes in the joint context suggested that additional action control was recruited when sharing a task with another. Taken together, the findings demonstrate that effects of action expertise and effects of co-action can be dissociated.

F45

IMPULSIVITY EFFECTS ON VOLUNTARY MOTOR PREPARATION Guido Band[1,3], Marlies van Bochove[2,3]; [1]Leiden Institute for Brain and Cognition, [2]Ghent University, [3]Leiden Institute of Psychology — Trait impulsivity may be associated with rapid motor activation or with low motor execution thresholds (jumping the gun). What does this mean for the timing of the awareness of the intention to act, as a function of impulsivity? If striatal dopamine levels determine the speed of both access to working memory and activation of responses, impulsivity would be hypothesized to be correlated to the onset of intention awareness. The Libet et al. (1983) experiment was replicated with students with variable degrees of impulsivity: Participants were instructed to voluntarily press a button and remember the exact moment of intention awareness with the help of rotating clock hand that they monitored. Readiness potentials (RP) and lateralized readiness potentials were compared between groups of high and low impulsive participants. Spontaneous eye blink rate was recorded as a proxy for individual dopamine levels. High relative to low impulsive participants showed a strikingly smaller RP amplitude and shorter onset latency before the action. No group difference was found in the relative speed of awareness. Interestingly, for both groups the reported time of awareness almost overlapped with the actual voluntary action, which is even longer after motor activation onset than in Libet's study. As in the Libet et al. study, the data show a temporal gap between the first signs of intentions and awareness thereof.

F47

BENDING BODIES AND ROBOTS ON THE MOVE: THE INFLUENCE OF PERCEPTUAL TRAINING ON ACTION PREDICTION Emily S. Cross[1], Waltraud Stadler[1], Jim Parkinson[1], Simone Schütz-Bosbach[1], Wolfgang Prinz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences — It has been proposed that the mirror neuron system (MNS) is involved in negotiating the interaction between action perception and production. Here we address the theory that the MNS subserves action prediction using a task where participants observe and predict occluded actions. We probe the flexibility of this system by using sequences that are beyond participants' motor repertoires (wind-up toy and gymnastic sequences). In between pre- and post-training neuroimaging sessions, participants were trained on a prediction task for a subset of toy and gymnastic videos. Behavioral findings indicate equivalent performance for trained gymnast and toy sequences. However, distinct neural systems were engaged by the different agents. These differences were most pronounced for the untrained compared to trained sequences. Predicting untrained compared to trained gymnastic sequences recruited inferior parietal lobule and premotor cortex, two core regions of the MNS. In contrast, predicting trained toy sequences recruited a large cluster in the occipital gyrus. For trained compared to untrained gymnastic sequences, greater activity was observed within midline cerebellum. No brain regions emerged from the comparable contrast for toy sequences. These results suggest that after perceptual training, less MNS activation is needed despite better task performance. In contrast, unfamiliar human stimuli activated the MNS and unfamiliar non-human stimuli activated visual cortices. Together, the findings provide evidence that the motor system is recruited for predicting complex human actions that one's own body cannot perform, but not for non-biological, mechanical actions.

F48

NEURAL PROCESSES AND ATTENTION CHARACTERISTICS OF ELITE AND ADVANCED FENCERS Jin Yan[1]; [1]The Chinese University of Hong Kong — The purpose of this study is to examine the characteristics of visual attention and the neural mechanisms underlying the decision-making processes and response speed and accuracy in professional fencers. In a visual-motor discrimination task wherein three levels of fencers (experts, advanced, and regular) determined the attacking and defending skills, eye movements and event related potentials (ERPs) were simultaneously recorded. Analyses indicate that the differences between fencer groups in reaction time (RT) and accuracy were not significant. However, to identify opponent's attacking and defending attempts, expert fencers were faster than lower-level fencers in controlling the visual fixation and saccade movements (the 1st fixation time, the 2nd fixation time, the 1st saccade time, mean saccade time, total fixation time, and mean fixation time). In several selected brain regions, elite fencers showed lower amplitudes in P1 and N2 and had shorter latencies in N2 and P3. A lower activation level in P1, N1, N2 and an earlier activation in N2 and P3 exhibited in the relevant brain regions among experts are interpreted in the border context the superior fencing performance. In fencing matches where it is critical to distinguish the skills used by the opponent, elite fencers directed their visual attention to key body parts more quickly and accurately. They required fewer cognitive resources for mental operation than their lower-level peers. Expert fencers have developed adoptive and efficient visual search strategies in gaining critical information for successful performance.

F49

CAN EYE HELP YOU? AN FMRI STUDY INTO THE EFFECTS OF 'SOCIAL GAZE' ON THE NEURAL CORRELATES OF ACTION CONTROL AS MEASURED BY A MANUAL STIMULUS-RESPONSE COMPATIBILITY TASK Leonhard Schilbach[1], Simon B. Eickhoff[2,3], Edna Cieslik[2,3], N. Jon Shah[2], Kai Vogeley[1]; [1]University of Cologne, [2]Institute of Neuroscience and Medicine, Research Centre Juelich, Germany, [3]University of Aachen, Germany — Previous evidence suggests that 'social gaze' can cause shifts in attention, but can also change the perception as well as the manipulation of objects located in the direction of gaze. Consistent with studies demonstrating that attentional orienting driven by social cues involves a different neural network than orienting driven by non-social cues, the latter may, therefore, imply differences in the networks subserving action control depending upon the stimulus type (social vs non-social). Here, we sought to explore this hypothesis by using a stimulus-response compatibility paradigm in which participants are asked to generate spatially congruent or incongruent motor responses to social and non-social stimuli while undergoing fMRI. Results of this 2x2 factorial design demonstrate that the perception of non-social stimuli – regardless of response type – leads to activation of extrastriate visual and posterior parietal cortex, while the perception of social stimuli results in activation of inferotemporal cortex, the amygdala and medial prefrontal cortex. Results further demonstrate recruitment of a fronto-parietal network for the generation of incongruent motor responses regardless of stimulus type, while congruent responses lead to recruitment of orbitofrontal cortex. Notably, a statistical interaction between the main effects was observed for incongruent responses to social stimuli in subcortical structures (dorsal striatum, cerebellum, mediodorsal thalamus) and left inferior frontal gyrus. Taken together these results, therefore, highlight differences in the recruitment of brain areas subserving action control depending upon the stimulus type with social stimuli resulting in a differential recruitment of subcortical structures previously implicated in implicit learning and reward-related processing.

F50

A VIRTUAL ENVIRONMENT-BASED PARADIGM FOR IMPROVING ATTENTION IN SEVERE TBI Assaf Y. Dvorkin[1,2], Milan Ramaiya[3], Felise Zollman[1,2], Eric Larson[1,2], Sonia Pacini[1], Nancy Hsu[1], James L. Patton[1,2,3]; [1]Rehabilitation Institute of Chicago, [2]Northwestern University, [3]University of Illinois at Chicago — Attention deficits are frequently observed after traumatic brain injury (TBI). Attention has been the target of various types of treatment and rehabilitation programs for TBI survivors. These methods have been shown to influence attention in the more chronic and higher functioning patients. However, studies that test the inpatient population are scarce. We have developed and performed a preliminary test of a haptic/graphic paradigm for improving attention and concentration in early stages of recovery in 15 severe TBI inpatients (Rancho Los Amigos Scale Levels of IV and V). Patients were tested on two successive days, where they held the handle of a robot and reached for visual targets that appeared one at a time in different locations within a three-dimensional virtual environment. During a reaching movement patients experienced (1) no haptic feedback, (2) a "break-through" force (similar to popping a balloon), or (3) a gentle pulse of force - a haptic nudge (if one second periods of near-zero speed were detected). Results showed that all patients were able to tolerate the experience, and chose to return for a second day. Furthermore, results showed improvement in target acquisition rates and average movement time during and across visits in nearly all patients. Our findings indicate benefits in some patients from the gentle nudge both before and during a movement. These patients regained concentration and were able to complete the reaching movement. These findings demonstrate preliminary feasibility and provide the foundation for a larger, intensive, protracted study with repeated treatment and clinical outcome evaluations.

F51

HOW UNCONSCIOUS EFFECT INFORMATION AND MOTOR PREDICTION CONTRIBUTE TO THE SENSE OF AGENCY: EVIDENCE FROM EVENT-RELATED BRAIN POTENTIALS Antje Gentsch[1,2], Simone Schütz-Bosbach[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Berlin School of Mind and Brain, Germany — The sense of agency refers to the experience of causing one's actions and their sensory effects and is assumed to be generated by a comparison between predicted and actual action effects. It has been suggested that an internal forward model computes these predictions on the basis of efferent information which can be used to attenuate sensory effects of self-produced movements and in this way distinguish them from externally generated effects. According to another view we infer agency independent of efferent information from observing covariances between prior thoughts and sensory events. Even though there is evidence for both accounts, their interrelation is so far poorly understood. The present study investigated whether suppression of the neurophysiological response to self- compared to externally generated action effects is influenced not only by internal efferent information but also by external preview information about the action effect. We measured event-related potentials (ERP) to visual effect stimuli in a forced-choice response task and an observation task, under different conditions of unconscious effect-priming and motor prediction. As expected, the N1 amplitude of the visual ERP was selectively reduced when action effects were self-generated. This N1 attenuation effect, as well as the explicit agency judgment, was furthermore modulated by predictability and priming of the action effect. These findings suggest that both efferent information and action effect anticipation provide important cues for the conscious experience of agency.

F52

GENOMIC IMPRINTING EFFECT ON CORTICOSPINAL EXCITABILITY IN TURNER SYNDROME Sara Tremblay[1,2], Jean-François Lepage[1,2], Maryse Lassonde[1,2], Cheri L. Deal[2], Hugo Théoret[1,2]; [1]Universite de Montreal, Québec, Canada, [2]Centre de recherche du CHU Ste-Justine, Québec, Canada — Turner Syndrome (TS) is a genetic disorder associated with partial or complete absence of one X chromosome in phenotypic females. Despite an IQ in the normal range, TS individuals typically show cognitive, physical as well as motor abnormalities. Interestingly, a genomic imprinting effect, a process by which genes are expressed in a parent-of-origin specific manner, is thought to influence cognitive and physiological traits in this population. The present study sought to investigate the motor neurophysiology of TS individuals with regards to genomic imprinting effects. Sixteen TS individuals (6Xpat, 10Xmat) and 12 matched controls underwent a TMS assessment of corticospinal excitability including short-interval intracortical inhibition (SICI), intracortical facilitation (ICF), long-interval cortical inhibition (LICI), motor threshold (MT) and motor cortex excitability during action observation. Imprinting trends were found on TMS measures of long-interval intracortical inhibition (LICI) where 45,Xmat individuals showed less GABAB-mediated motor cortex inhibition than 45,Xpat participants. MT, SICI and ICF showed no imprinting trends and values were similar to those observed in healthy controls. No impriting trends or differences with the control group were found for action observation. These data suggest an effect of parent-of-origin X chromosome on corticospinal excitability in Turner Syndrome.

F53

EFFECTS OF UTTERANCE RHYTHM ON SPEECH PLANNING: AN MEG STUDY Sam Tilsen[1], John Houde[2], Emily Moeng[1], Kevin Sitek[1], Srikantan Nagarajan[2]; [1]University of California, Berkeley, [2]University of California, San Francisco — Speech rhythmic processing has previously been associated with activation in the right-hemisphere superior temporal gyrus, but it is unclear whether low-frequency theta (4-8 Hz) and alpha (8-12 Hz) band oscillations are related to the behavioral rhythms of a planned utterance. The rhythmic patterns of target utterances in a prepared speech/working memory task were controlled in order to contrast metrically regular utterances (four trisyllabic nonsense words, each with a stressed-unstressed-unstressed metrical pattern) with phonologically-matched metrically irregular utterances. Data were acquired from 8 participants using a 275-channel whole-head biomagnetometer (CTF Systems, Vancouver BC) and analyzed in the time-frequency domain using Nutmeg (bil.ucsf.edu/nutmeg). During the later part of the preparation phase, the majority of subjects exhibited significantly more induced synchronization in theta (4-8 Hz) and alpha (8-12 Hz) bands in right-STG on the rhythmically irregular trials compared to the regular ones. This difference is suspected to arise from greater effort required to maintain the irregular pattern in working memory. In contrast, at the onset of and prior to the preparation phase, subjects tended to exhibit in STG bilaterally a relatively greater alpha thru high-gamma band (8-135 Hz) synchronization on regular trials. This is suggested to reflect facilitation—due to rhythmic regularity—of the initial encoding of the utterance in working memory. Behavioral results reinforce these interpretations: error rates were lower and rates of articulation were faster on the rhythmically regular trials. Further, the correlation between theta and alpha activity in left and right STG was predictive of error rates in the task.

F54

SOMATOTOPIC REPRESENTATION OF LARYNGEAL AND SUPRALARYNGEAL ARTICULATORY MOVEMENTS IN THE SENSORIMOTOR CORTEX Krystyna Grabski[1], Laurent Lamalle[2,3], Coriandre Vilain[1], Jean-Luc Schwartz[1], Nathalie Vallée[1], Irène Troprès[2,4], Monica Baciu[5], Jean-François Le Bas[6], Marc Sato[1]; [1]Gipsa-Lab, CNRS & Grenoble Universités, France, [2]Institut Fédératif de Recherche n°1 "RMN Biomédicale et Neurosciences", CHU de Grenoble, France, [3]INSERM, France, [4]Université Joseph Fourier, Grenoble, France, [5]Laboratoire de Psychologie et NeuroCognition, CNRS & Université Pierre Mendès France, Grenoble, France, [6]Centre Hospitalier Universitaire de Grenoble, France — Since Penfield's seminal work on electrocortical stimulation, brain imaging studies have confirmed a general somatotopic functional organization related to parts of the human body in the sensorimotor cortex. However, few studies have investigated the possibility to discriminate distinct representation sites of laryngeal and supralaryngeal articulations. In the present study, we used functional magnetic resonance imaging to further test a possible somatotopic organization of larynx, lip, jaw and tongue articulatory movements. In order to minimize movement-related imaging artifacts, a sparse sampling acquisition technique was used, where the motor task occurred during a silent interval between successive image acquisitions. To delimitate cerebral activations specific to supralaryngeal articulations, we had participants perform independently lip protrusion, jaw lowering and tongue retroflex movements. Additionally, for laryngeal activities, we looked for cerebral activation corresponding to the production of the /i/ vowel. For all movements, a group analysis revealed strong bilateral activations within the sensorimotor cortex as well as within the supplementary motor area and the anterior cingulate gyrus, the inferior frontal gyrus, the insula, the inferior parietal lobule, the putamen, the thalamus and the cerebellum. At the individual level, a dorso-ventral bilateral somatotopic organization of lip, jaw, larynx and tongue articulators, respectively, was detectable in the sensorimotor cortex and could be spatially discriminated for the great majority of the participants. The individually proven possibility to differentiate the sensorimotor representation sites of lip, jaw, larynx and tongue movements is of particular interest for studies investigating speech motor control and disorders as well as cortical plasticity after neurosurgery.

F55

SEX DIFFERENCES IN MOVEMENT SEQUENCING AS RELATED TO COMPLEXITY Gabriel Leonard[1], Joelle Crane[1], Alain Ptito[1], Catherine Evans[2]; [1]Montreal Neurological Institute, McGill University, [2]University College, Oxford — Studies in human and nonhuman primates indicate that lesions involving the frontal cortex impair the performance of complex motor acts even when the precentral gyrus is spared. Of particular interest is the fact that unilateral lesions of the supplementary motor cortex give rise to deficits on bimanual co-ordination tasks in which the two hands must perform different actions simultaneously (Brinkman 1981). Using the Thurstone Tapping Task, we have demonstrated this type of discoordination in human subjects with frontal lobe lesions (Leonard, Milner, and Jones, 1988). We concluded that the deficits displayed by the frontal lobe subjects were related to difficulty in switching from an external form of control (reliance on visual and kinesthetic feedback for the guidance of each movement) to an internal form of control such that the subjects' internal representation of the complex movement sequence are not efficiently encoded. In normal subjects, we showed that sex differences recorded in simple motor speed disappear as task demands increase; men are faster for simple repetitive tapping, but no sex differences are evidenced for unimanual or bimanual sequential tapping. We have now computerized this device and will present our most recent findings on 300 normal subjects. The findings confirm robust sex effects in rapid repetitive movements but when sequencing of movements is required, both unimanual and bimanual, the male advantage disappears.

F56

AUDITORY FEEDBACK DURING VOCAL PRODUCTION IS COMPARED TO PREVIOUS Colin Hawco[1,2], Jeffery A. Jones[2]; [1]McGill University, [2]Wilfrid Laurier University — During speech and singing, auditory feedback is used to ensure that motor output matches expectation, and to correct online for errors. When speakers hear the fundamental frequency (F0) of their voice altered, they shift their F0 in the direction opposite to the perturbation. Event-related potentials (ERPs) were recorded while participants vocalized an /ah/ sound for 3 seconds. Participants either matched a target note or produced at a habitual pitch during separate experimental sessions. Auditory feedback was shifted by 0 cents, 25 cents, 50 cents, 100 cents, or 200 cents for a 100 ms period in the middle of the utterance. A mismatch negativity (MMN) was observed, with the amplitude positively related to the size of the perturbations. No differences were found between sessions. These results suggest that auditory feedback is compared to the F0 prior to shift, rather than to a specific F0 target (such as the target note). A second behavioural study confirmed this interpretation. Participants vocalized, matching a target note. In half of all trials, a 100 cent perturbation was introduced prior to vocalization. A mid-utterance perturbation could then be introduced by removing the existing perturbation for 500 ms. In control trials, a mid-utterance perturbation was introduced without an onset perturbation. F0 compensation to mid-utterance perturbations was identical to onset and control trials, and was always smaller than the compensation to the onset shift. This confirms that the baseline, preshift F0 is used as the comparator when detecting errors in auditory feedback.

F57

DIFFERENTIAL ROLES OF THE FRONTAL AND PARIETAL CORTEX IN THE PREPARATION OF EXOGENOUS AND ENDOGENOUS SACCADES Julia Bender[1], Kyeong-Jin Tark[2], Norbert Kathmann[1], Clayton E. Curtis[2]; [1]Humboldt Universitaet zu Berlin, Institut für Psychologie, Abteilung Klinische Psychologie, Berlin, [2]NYU, Center for Neural Science, New York University, NY — Although externally as well as internally guided eye movements allow us to flexibly explore the visual environment, their differential neural mechanisms remain elusive. A better understanding of these neural mechanisms will help us understand the control of action and help us to elucidate the nature of cognitive deficits in certain psychiatric populations (e.g. schizophrenia) that show increased latencies in voluntary but not visually guided saccades. Both the frontal eye field (FEF) and the intraparietal sulcus (IPS) have been associated with control of eye movements. However, it remains unknown what differential contributions the two areas make to the programming of visually guided and voluntary saccades. In this study we tested the hypotheses that 1. IPS has a distinct neural representation of visually guided saccades and 2. voluntary saccades need stronger FEF control by scanning thirteen healthy subjects with fMRI while they generated exogenously and endogenously cued delayed saccades. After a cue (exogenous = peripheral dot; endogenous = arrow at central fixation), subjects prepared an eye movement that was delayed until a go response was given. We used Multi-Voxel Pattern Analysis to test whether patterns of preparatory activation could be used to predict the direction of the planned eye movement and whether the movement was exogenously or endogenously guided. Preliminary results indicate that patterns in the IPS better predicted exogenously cued saccades and patterns in the FEF better predicted endogenously cued saccades. The results support the hypothesis that the FEF and IPS make distinct contributions to the control of eye movements.

F58

NEURAL CORRELATES OF EYEBLINK CONDITIONING Jerillyn Kent[1], Benjamin Pruce[1], D. Michael Bailey[1], Jennifer Vollmer[1], Sharlene Newman[1], William Hetrick[1]; [1]Indiana University — Eyeblink conditioning (EBC) is a widely used measure of associative learning in both animal and human studies, with a well preserved response across species. The delay EBC procedure consists of an unconditioned stimulus (airpuff) that elicits an unconditioned response (eyeblink) being paired with a co-terminating conditioned stimulus, such as a tone. With repeated paring of the airpuff and tone, a subject will display a conditioned response (eyeblink) to the tone before delivery of the airpuff. Animal and human lesion studies indicate a critical role of the cerebellum in delay EBC. However, the neural circuitry of EBC in healthy humans has yet to be fully elucidated. The purpose of the current study was to identify the neural correlates of EBC in healthy human participants using functional magnetic resonance imaging (fMRI). Healthy young adults were scanned in a 3T Sieman's TRIO during a delay EBC procedure. The experiment consisted of 4, 11.5 minute runs. The first run was a pseudo-conditioning run in which 26 tones and 26 airpuffs were randomly presented. The remaining runs were conditioning runs in which 52 tone/airpuff pairs were presented with a 400 ms tone and a co-terminating 50 ms airpuff to the left eye. Group maps comparing the last block of conditioning to the first showed increased activation in the left (ipsilateral) cerebellum and the left temporal/occipital cortex. The results support the theory that the cerebellum is crucial for EBC, and demonstrate the feasibility of measuring the neural activity associated with EBC using fMRI.

F59

CAN IPSILATERAL MOVEMENT REACTION TIME ADVANTAGES BE EXPLAINED BY WITHIN VERSUS BETWEEN HEMISPHERE PROCESSING? David Carey[1]; [1]University of Aberdeen — Movement made to targets on the same side of the body midline are faster and more accurate than movements made to targets on the opposite side of the body. These "ipsilateral" advantages are typically interpreted as a result of within-hemisphere control of the movement However, these effects may follow biomechanical differences between ipsilateral and contralateral movements (Carey & Otto-de Harrt, Neuropsychologia, 39, 885-861, 2001; Carey, Hargreaves and Goodale, Exp Brain Res, 112, 496-504, 1996). Barthélémy and Boulinguez (Exp Brain Res, 147, 305-312, 2002) have argued that reaction times may be an exception to a biomechanical explanation, which is more sensibly applied to post movement onset measures such as the peak velocity and duration. To evaluate their claim, we used an antipointing-pointing paradigm. Twenty-six right handed participants reached in separate antipointng and pointing blocks to one of six randomly appearing targets and were recorded at 240 Hz. In pointing, we found advantages for ipsilateral targets, which then allowed for a test of the within versus between hemisphere model using antipointing. In antipointing, this advantage reversed, providing strong support for a more biomechanical explanation, such as the inertial anisotropy account. In addition, the same effects were found for duration and peak velocity. Although within versus between effects are found in some studies, when whole arm movements which vary substantially across the workspace are required, biomechanical effects dominate.

F60

RELATIONSHIP BETWEEN COGNITIVE ACTIVITY AND ELECTROENCEPHALOGRAM IN HEALTHY ADULTS 60 YEARS AND OLDER Milene Roca-Stappung[1], Thalía Fernández, Thalía Harmony, Judith Becerra, Marbella Espino; [1]Instituto de Neurobiologia, UNAM, [2]Universidad Autónoma de Querétaro — There are few studies about healthy, elder individuals, and yet fewer advocating to the study of their EEG. This group will soon be a wide part of the population, therefore, research is imperative in this field. This study had two goals: a) to describe the results of the Wechsler Adult Inteligence Scale - Third Revision and of the values obtained from quantitative analysis of the EEG in healthy adults 60 years and older, and b) to explore the relationship between the WAIS-III scores and EEG values in this group. Referential EEG was recorded in the 19 leads of the 10-20 System and WAIS-III was applied to healthy, active adults (60-84 y.o.). A correlation analysis was made between the Z absolute power (AP) and relative power (RP) values of delta, theta, alpha, and beta bands and WAIS-III scores. Lower values of delta AP, and delta and theta RP, were significantly related to better scores in the WAIS-III subtest scores, while an unexpected relationship was observed between higher theta AP values and performance subtests. There were few significant relationships accounting to alpha and beta activity, but generally, better cognitive performance was associated with higher alpha and beta AP and RP values. These results suggest that it would be important to include the WAIS-III in neuropsychological evaluations done in this age group, paying special attention to information, similarities, and letter-number sequencing verbal subtests, and picture completition, block design, and symbol search performance subtests, which correlated most significantly with EEG values. Supported by PAPIIT-ES216707.

F61

EYE CONTACT ENHANCES MIMICRY OF INTRANSITIVE HAND MOVEMENTS Yin Wang[1], Roger Newport[1], Antonia Hamilton[1]; [1]School of Psychology, University of Nottingham, UK — Mimicry and eye contact both play a pivotal role in social interaction. When two people meet in a bar, a subtle interplay of social behaviours, such as eye contact and unconscious mimicry of actions plays an important role in how much the individuals like each other by the end of the evening. However, it is not known how these different social signals interact. Here, we adopt a rapid mimicry paradigm, to test if eye contact can modulate mimicry on a second by second timescale. We adopted a stimulus-response compatibility paradigm used by Heyes and colleagues, in which participants respond to a hand-opening or hand-closing stimulus by either opening or closing their own hand in different blocks. Before each hand action trial, we presented a movie of a woman naturally performing a head movement which resulted in direct gaze or averted gaze. Two experiments involving 43 participants consistently demonstrated that direct eye contact rapidly and specifically enhances mimicry of hand actions. In particular, direct gaze facilitates the mimicry of hand action by 15 msec, compared to averted gaze. Control conditions rule out an effect of spatial attention, suggesting that eye contact is more than just an arousal and attentional signal. Our findings have important implications for understanding the role of eye contact as a controlling signal in human non verbal social behaviour, as well as a facilitative signal in social learning.

F62

THE NEURAL CORRELATES OF FITTS'S LAW IN AN ACTION OBSERVATION TASK: AN FMRI STUDY Terry Eskenazi[1], Pia Rotshtein[2], Marc Grosjean[3], Guenther Knoblich[1]; [1]Radboud University Nijmegen, the Netherlands, [2]University of Birmingham, UK, [3]Leibniz Research Centre for Working Environment and Human Factors, Dortmund, Germany — Previous neuroimaging studies support the assumption of a strong link between perception and action, demonstrating that the motor system is involved when others' actions are observed. One question that is still open to debate is which aspect of observed actions engages the motor system. Proposed alternatives include movement kinematics and the context of a movement. The present fMRI study used Fitts's law to disentangle different movement aspects. Fitts's law postulates that the difficulty of any biological movement (ID) is a function of the distance to the target (A) and the target width (W). In an action observation task, ID of the observed action was manipulated orthogonally to W (by using 5 different As). The results revealed increasing activation in primary motor cortex, supplementary motor area, and basal ganglia in response to increasing ID levels. Thus activation of the motor system during action observation is driven by how difficult it would be for the observer to perform the action.

F63

DISSOCIATING THE ROLES OF THE LATERAL AND MEDIAL PREFRONTAL CORTEX IN MEDIATING SPEED-ACCURACY TRADE-OFFS DURING RESPONSE PREPARATION IN A GO/NO-GO TASK Ryan Blagdon[1], Chris Bowen[2], Benjamin Rusak[3], Jason Ivanoff[1]; [1]Saint Mary's University, Halifax, NS, [2]National Research Council Institute for Biodiagnostics (Atlantic), Halifax, NS, [3]Dalhousie University, Halifax, NS — The speed-accuracy trade-off (SAT) refers to the inverse relationship between the speed and accuracy of decisions. We used slow event-related fMRI to isolate the effects of SAT on neural activation associated with different stages of decision-making. Participants received a sequence of three different visual signals which indicated i) whether to emphasize speed ('SPD') or accuracy ('ACC') in responding; ii) the correct response (a left or right key-press, indicated by the gender of a face image); and iii) whether the correct response was to be executed or withheld ('Go' or 'No-Go', indicated by an image of either a single- or two-storey house). Consistent with previous research, SAT instructions did not have a pronounced effect on activation in posterior sensory regions, while frontal regions were much more sensitive to the SAT instructions. Activation in the medial frontal cortex was greater after a SPD cue than an ACC cue, before presentation of the response cue (i.e., face), also consistent with previous research. In contrast, activation in lateral frontal regions increased more for ACC trials than SPD trials only after the response cue (i.e., the face image) appeared. These results suggest that the medial and lateral frontal regions are differentially engaged by instructions to emphasize the speed versus accuracy of responding during different phases of perceptual decision-making.

F64

IDENTIFICATION OF THE AGENT MATTERS: N1 COMPONENT IS MODULATED BY THE SELF-OTHER DIFFERENTIATION Pamela Baess[1], Antje Holländer[1], Wolfgang Prinz[1]; [1]Max-Planck-Institute of Human Cognitive and Brain Sciences, Leipzig, Germany — Previous studies have shown that perceiving another's action activates to a certain degree the corresponding representations in the observer's action system. With the means of electroencephalography (EEG), these differences were reported in the motor preparation potentials or following the action-associated stimuli. However, less is known about when this co-representation of the other's action occurs. In the present EEG study, we have investigated how performing a task with another person affects the processes of the identification of the agent ("my turn", "other's turn", "no-one's turn") and the preparation for the appropriate response (left hand vs. right hand). Therefore we used a paradigm where the processes of the identification of the agent and the preparation of the response before the action-associated stimuli (Go-Signal) can be disentangled. Reaction times and event-related potentials were measured while participants performed a Go/No-Go task alone (single condition) and with another person (joint condition). In both conditions, the N1 response was smallest for action-associated stimuli that referred to one's own action. Further, the N1 component was differently modulated in the joint vs. the single condition. In the joint condition, the N1 response for the other's action was smaller compared to the one for no-one's action. This pattern did not occur in the single condition when the participants performed the task alone. Thus, the N1 amplitude modulation might reflect the strength of the action-associations. This gives evidence that the identification of one's own action vs. the other's action already modulates early processing stages before the actual response.

F65

DEALING WITH ACTIONS OR DEALING WITH ACTORS? FROM MOTOR SIMULATION TO THEORY OF MIND Moritz F. Wurm[1], D. Yves von Cramon[1], Ricarda I. Schubotz[1]; [1]Max Planck Institute for Neurological Research — Action observation is usually associated with activity in the higher motor system, while reflecting about other agent's mental states engages the so-called theory of mind (ToM) network. Whereas recent studies on action observation suggested that such reflections about mental states are triggered only for implausible or new actions, the ToM network may be also active during observation of normal actions, but may be obscured by contrast building. In the present fMRI study we tested the hypothesis that, first, an allocentric perspective on normal actions, and second, the sight of the actor's face suffices to evoke ToM activity. Observing actions from an egocentric perspective resulted in increased activity of the higher motor system, whereas allocentrically perceived actions additionally enhanced activity in ToM areas, more precisely the temporo-parietal junction (TPJ) bilaterally, the ventromedial prefrontal cortex (vmPFC) and the posterior cingulate cortex (PCC). Among these areas, the presence of a face further enhanced activity in vmPFC and PCC. Moreover, vmPFC and the precuneus were enhanced when the actor differed from that in the preceding trial. These findings indicate that considerations about other agent's mental states, as far as reflected by activation of the ToM network, can arise during observation of normal everyday actions, and that an allocentric perspective, the sight of the actor's face and the presentation of a new actor function as potential triggers.

F66

NEURAL CHANGES FOR SPEECH MOTOR ADAPTATION Vincent Gracco[1,2,5], Douglas Shiller[1,3], Marc Sato[1,4], Shari Baum[1,2]; [1]Centre for Research on Language, Mind and Brain, [2]McGill University, [3]l'Université de Montréal, [4]Université Stendhal, [5]Haskins Laboratories — Speech motor adaptation refers to changes in motor output in response to short but intensive periods of practice under feedback altering conditions. Speech motor adaptation has been evaluated behaviorally in response to manipulations of auditory and orosensory feedback, yielding indirect evidence of short term neural plasticity. In a recent behavioral study, we reported compelling evidence for a strong sensorimotor coupling evidenced by simultaneous changes in both speech motor output and speech perception. Here we focus on the neural changes associated with sensorimotor adaptation. Functional MRI data were acquired while subjects produced single words in the scanner. After acquiring baseline trials, auditory feedback was gradually altered (3 semitone shift) over thirty trials and then maintained for 120 trials. Changes in neural activation and acoustic speech output were assessed following the initial feedback manipulation, and over the course of the practice period. Comparison of initial and adapted periods revealed increased activations in the inferior frontal gyrus extending to the ventral premotor and primary motor cortex, in the anterior part of the insular cortex and in the superior and middle temporal gyri bilaterally. These increases gradually subsided over the course of the practice while the acoustic evidence suggested maintained compensation for the altered feedback. These results reflect the interactive nature of speech production and speech perception and suggest that speech motor adaptation results in a change in synaptic weights over the course of a single experimental session. Sensorimotor adaptation provides a robust means to assess the dynamics of brain plasticity for speech.

F67

NEUROANATOMICAL CORRELATES OF LONG-TERM VOCAL TRAINING Boris Kleber[1,2,3], Christina Moll[1], Ralf Veit[1], Christian Gaser[4], Martin Lotze[5], Niels Birbaumer[1,6]; [1]University of Tübingen, Germany, [2]McGill University, Montreal Neurological Institute, Montreal, Canada, [3]International Laboratory for Brain, Music, and Sound Research, Montreal, Canada, [4]University of Jena, Germany, [5]University of Greifswald, Germany, [6]Ospedale San Camillo, Venezia, Italy — Playing an instrument or singing at a professional level requires the perfect integration of cognitive processes with highly complex sensorimotor coordination. Studies have shown that playing an instrument for many years results in task-specific gray matter changes (i.e. cortical expansion) in areas related to sensorimotor control, right auditory cortex, as well as increased cerebellar volume and a larger anterior corpus callosum. In contrast to instrumentalists, professionally trained singers utilize a motor system that already operates at a comparably high level of motor complexity during everyday activities, such as speaking. However, many years of training are still required to achieve superior levels of voice control. To date, very little is known about the neuroanatomical consequences of long-term vocal skill training. In a recent functional MRI experiment, we demonstrated that expertise in classical singing correlated with increased blood oxygenation in bilateral somatosensory cortex, inferior parietal lobe and the cerebellum. This suggests that as they gain experience, singers increasingly recruit proprioceptive information from the laryngeal muscles for controlling their vocal output. Based on these results, the present study used voxel-based morphometry (VBM) to analyze gray matter differences in participants with and without vocal training. We compared 27 professionally trained vocal students with 27 age and gender matched non-singers. We found that long-term vocal training is reflected by cortical expansion in both the somatotopic larynx area in the right primary somatosensory cortex, and in the right primary auditory cortex. Results are discussed within concepts of music processing and cognitive control of vocal motor function.

F68

EFFECTS OF AEROBIC FITNESS ON AGING RELATED CHANGES IN INTERHEMISPHERIC COMMUNICATION Keith McGregor[1,2], Zvinka Zlatar[1,2], Kleim Erin[1], Bauer Andrew[2], Phan Stephanie[1,2], Seeds Lauren[1], Kleim Jeffrey[1,2], White Keith[1,2], Crosson Bruce[1,2]; [1]Malcom Randall VA Medical Center, Gainesville, FL, [2]University of Florida — Aerobic fitness has been offered as a potential buffer against aging related changes in the human neural system. In the human motor system, recent evidence from neuroimaging and neurophysiology has indicated that aging may be associated with a loss of interhemispheric inhibition during unimanual task activity. We set out to test the effects of aerobic fitness on interhemispheric communication using transcranial magnetic stimulation (TMS) and functional magnetic resonance imaging (fMRI) on a cross-section of 15 highly fit and 15 sedentary elderly (>60 years) adults. Data from 15 younger adults (18-37 years) were also acquired for comparison. Participants engaged in unimanual fMRI (index finger to thumb opposition) and TMS (ipsilateral silent period) tasks previously shown sensitive to changes in interhemispheric communication. In fMRI, sedentary elderly adults recruited motor hand areas in the primary motor cortex bilaterally, while younger and fit elderly adults showed negative BOLD activity in the ipsilateral motor hand bump indicating a potential inhibition of this cortical area. During TMS, both younger adults and fit older adults evidenced significantly longer ipsilateral silent periods than did the sedentary elderly group. These data indicate that aerobic fitness may serve to mitigate a loss of interhemispheric inhibition in the motor system.

F69

SENSORIMOTOR ABILITIES AMONG EARLY AND LATE-TRAINED MUSICIANS Jennifer A. Bailey[1,2], Amanda Daly[1,2], Virginia Penhune[1,2]; [1]Concordia University, [2]International Laboratory of Brain, Music, and Sound Research (BRAMS) — Previous work from our laboratory (Watanabe et al., 2007) demonstrated that musicians who began training before age 7 (early-trained; ET) outperformed those who began after age 7 (late-trained; LT) on a visuomotor synchronization task, when controlling for years of formal training and experience. Another study revealed that ET musicians outperformed LT musicians on an auditory rhythm synchronization task as well (Bailey and Penhune, in press). Additionally, despite no group differences on cognitive measures, performance on the rhythm task correlated with individual working memory scores across musicians. These results provide support to the idea of a "sensitive" period for sensorimotor learning via musical training that cannot be attributed to group differences in cognitive ability. An important question to be addressed is whether performance differences would be observed on other musical tasks. The present study addresses this question by comparing ET and LT musicians on the auditory rhythm synchronization task (Chen et al., 2008; Bailey and Penhune, in press), a melody discrimination task (Foster et al., 2009), and a pitch naming task (Bermudez et al., 2008). In addition, cognitive measures were administered. While no group differences were observed on the cognitive measures, the ET group outperformed the LT group in terms of their rhythm synchronization abilities and transposed melody discrimination abilities; however, no group differences were observed on the pitch task. These results will be discussed in terms of support for a "sensitive" period for sensorimotor learning via musical training.

F70

RESPONSE SELECTION DEFICITS IN SCHIZOPHRENIA: EVIDENCE FROM LATERALIZED MOVEMENT-RELATED AND ATTENTION-RELATED BRAIN POTENTIALS Benedikt Reuter[1], David Möllers[1,2], Lisa Kloft[1], Jürgen Gallinat[2], Norbert Kathmann[1]; [1]Humboldt-Universität zu Berlin, [2]Charité Universitätsmedizin Berlin — Slowed reaction time has been documented consistently in research on schizophrenia. Here we follow the hypothesis that the slowing reflects a generalized deficit in response selection, including the activation of simple manual responses. Recent findings of increased onset latencies of the lateralized readiness potential (LRP) in schizophrenia patients might indicate a slowing of response selection processes but could also be due to delayed allocation of attention to imperative stimuli. In the present study with 20 schizophrenia patients and 20 matched healthy control subjects, we use a Simon-type spatial compatibility task for combined assessment of onset latencies of the LRP and the N2pc of the event-related potential – an electrophysiological correlate of the focusing of attention. The data suggest that this methodology is suitable to dissociate impaired response selection from normal attention allocation processes in schizophrenia.

F71

EFFECT ANTICIPATION AND SENSORY SUPPRESSION IN VOLUNTARY ACTION Gethin Hughes[1], Florian Waszak[1]; [1]Université Paris Descartes — A recent study (Bass et al. 2008) showed that the frontocentral auditory N1 event-related potential (ERP) component was suppressed for auditory tones following a voluntary action, as compared to tones presented alone. They concluded, in line with evidence from previous functional imaging studies (Blakemore et al., 1998), that cortical responses to action effects are suppressed. The aims of the current study were two-fold. Firstly, we aimed to replicate these sensory suppression effects in the visual domain. An advantage of using visual stimuli was to enable us to disentangle frontocentral ERP activity associated with motor action from posterior ERP components associated with the visual stimulus. Secondly, we included a new comparison to explore differences during motor preparation between voluntary actions associated with an action-effect and voluntary actions for which no effect was delivered. Our results confirmed a significantly larger readiness potential for actions for which a subsequent effect was expected. This difference may reflect the ERP marker of an efference copy which codes for the consequences of an action. In relation to sensory suppression, we observed no significant differences between "action-to-effect" and "effect only" conditions in the visual P1 component. However, we found significantly reduced frontocentral negativity from around 150ms after stimulus onset, as well as a reduction in the parietal P300, for action-to-effect trials. These findings suggest that although the initial sensory consequences of visual action effects were not suppressed, later processing of the visual stimuli is attenuated when it appears in response to a voluntary action.

F72

INTEGRATING BODY AND MIND: P3 MODULATION SUPPORTS AN EMBODIED VIEW OF MENTAL ROTATION Jennifer Stevens[1], Nathaniel Lucena[2], Whitney Cole[3]; [1]College of William & Mary, [2]Washington University, [3]New York University — Embodied cognition portrays cognitive processing as an artifact of the state of the body. Specifically, mental performance can be facilitated when the body is engaged in posture or action consistent with the cognitive task. Some studies demonstrate this facilitatory effect in behavioral paradigms through increases in processing time when there is incongruency between cognitive task and current body position. The present study uses the event related potential (ERP) signal to examine how this effect may be realized at the cortical level. Participants were asked to identify stimulus images presented at various angles of rotation as either left or right hands. Compared to controls, participants who completed the task with hands confined displayed two specific waveform deviations: increased N1 amplitude overall and a decreased P300 in the left hemisphere. The significant between-group ERP differences occurred despite the two groups' similarity in reaction time-angle of orientation functions. These results reveal a body-up modulation of the cortical signal mediating the cognitive task. Specifically, when the observer's stimulus-relevant hands were confined the P300, identified as a marker for motor inhibition, was decreased even though overall processing time was unaffected.

F73

HIGH GAMMA BAND SYNCHRONY CONTRIBUTES TO ACTION-INDUCED MODULATION OF AMBIGUOUS MOTION Kelly Jantzen[1], Benjamin Richardson[1], Sarah North[1], Mathew Seifert[1], Charles Odell[1], Aaron Tripp[1], Lawrence Symons[1]; [1]Western Washington University — A growing body of evidence reveals that parietal and prefrontal cortex moderate the direct mapping between perception and action. Although focus has been on how perception can influence action via motor resonance, common coding theories predict that action can also influence perception via perceptual resonance. Such hypotheses have been supported by behavioral work demonstrating that the perceived direction of ambiguous apparent motion is "captured" by the direction of an accompanying hand movement. The current study used EEG to investigate the neural basis of this "perceptual capture" of apparent motion. Participants made circular joystick movements while viewing an array of dots arranged in a circular pattern. The display was rotated such that the perceived direction of motion could be either ambiguous (A) or forced (F) to occur in the same direction as the movement. In A, movement captured the perception such that rotation was perceived in the same direction as joystick rotation. Additional conditions in which participants moved (M) in the absence of apparent motion and viewed ambiguous motion (AM) in the absence of movement were also included. High gamma band (70-120 Hz) activity recorded over contralateral parietal-frontal sites was greatest for the F condition and lowest for the AM condition, with the A and M condition falling somewhere between. Thus it appears that gamma synchrony reflects directional specificity of the apparent motion. We hypothesize that gamma band synchrony within parietal-premotor circuits underlies sensorimotor coupling and the ideomotor influences on perceptually ambiguous stimuli.

F74

MOTOR AND VISUAL EXPERIENCE REDUCES IMPLICIT ANALYSIS RELATED AREAS OF CORTEX Olave Krigolson[1], Suzan Nouwens[1], Todd Handy[1]; [1]University of British Columbia — Previous research has demonstrated that motor experience leads to reduced activation in visual and motor regions of cortex during passive viewing of graspable objects. Here, we sought to affirm whether this reduction in activation was actually due to motor experience or simply due to increased visual familiarity. Participants were either scanned with functional magnetic resonance imaging (fMRI) or had event-related brain potentials (ERP) recorded while passively viewing novel graspable objects (rock climbing holds) or novel control objects (size and colour matched wooden blocks). Following the initial viewing session, participants completed a six week training program during which they gained motor experience with the graspable objects and visual familiarity with the control objects. Subsequent to this, participants were scanned again with fMRI or had ERP data recorded during passive viewing of the graspable and control objects. Our fMRI results demonstrate that motor experience leads to reduce activation in motor regions of cortex, whereas visual familiarity leads to a reduction in activation in visual processing areas of the brain. In a similar fashion, learning related changes were observed in the ERP data with regard to components associated with visual processing of objects. Specifically, we found a learning related reduction in visual ERP component amplitude which we believe relates to increased object familiarity. In sum, these data imply that motor and/or visual experience leads to reduced processing in the related areas of cortex during passive viewing of graspable objects.

F75

NEURAL STRATIFICATION OF SEQUENCING AND TIMING IN AUDITORY FEEDBACK? AN FMRI STUDY Peter Pfordresher[1], Jennifer Cox[1], Michelle Andrews[1], James Mantell[1], Steven Brown[2], Robert Zivadinov[1]; [1]University at Buffalo, the State University of New York, [2]McMaster University — Alterations of auditory feedback during piano performance can be profoundly disruptive to performance. Furthermore, different alterations can yield different behavioral effects. Whereas alterations of feedback synchrony disrupt performed timing, alterations of feedback pitch contents can disrupt accuracy. These effects suggest that sensorimotor associations are stratified with respect to timing and sequencing (cf. Pfordresher, 2006). The current research tested whether these behavioral dissociations correlate with differences in brain activity. Twenty pianists performed simple melodies while being scanned in a 3-Tesla magnetic resonance imaging (MRI) scanner. In different conditions they experienced normal auditory feedback, altered auditory feedback (asynchronous delays or altered pitches), or control conditions that excluded movement or sound. Behavioral results replicated past findings, summarized above. With respect to neuroimaging data, reliable effects emerged when contrasting conditions with auditory feedback (normal or altered) against control conditions that involved playing without feedback (which reveals auditory activity). While playing with normal feedback, primary centers of activity were in the primary and secondary auditory cortices. Performances with asynchronous delays led to increases in areas associated with working memory (e.g., BA 46), whereas performances with disruptive pitch alterations simply led to increases within areas also active during normal feedback. Disruptive effects may therefore follow from different neural responses to altered feedback. For asynchronous data, disruption of timing may lead to compensatory activity in working memory. By contrast, alterations of pitch may lead to subtler neural effects based on synchronization with actions; disruption may result because the brain does not fully distinguish altered from normal feedback.

Long-Term Memory: Skill Learning

F76

DOPAMINE TRANSPORTER GENOTYPE PREDICTS IMPLICIT SEQUENCE LEARNING BUT NOT IMPLICIT SPATIAL LEARNING Jessica Simon[1], Melanie Stollstorff[1], Lauren C. Westbay[1], Chandan J. Vaidya[1,2], James H. Howard[1,3], Darlene V. Howard[1]; [1]Georgetown University, [2]Children's Research Institute, Children's National Medical Center, [3]Catholic University — Implicit learning (IL), the non-conscious acquisition of environmental regularities, underlies skills such as language acquisition and social judgments. Research from patients, animal models and pharmacological interventions suggests that dopamine may be associated with IL. We examined relationships between a polymorphism of the dopamine transporter gene (DAT1), which influences DAT expression in the striatum, and two forms of IL that differ in the regularity to be learned and in striatal involvement. Participants, grouped as 9-repeat carriers or 10/10, completed the Triplets Learning Task (TLT) and the Spatial Contextual Cueing Task (SCCT). The TLT assesses sequence learning, recruiting the dopamine-dependent frontal-striatal system, whereas the SCCT assesses spatial context learning, recruiting medial temporal brain networks. For the TLT, participants viewed open circles that first became red, then green (target) in discrete, three-event trials or "triplets" and responded to only the green target. Triplet frequencies were manipulated, with high frequency triplets occurring nine times more often than low frequency triplets. For the SCCT, participants viewed arrays of eleven distracters and one target, and responded to the target's orientation. Half the arrays repeated and half were novel. For both tasks, participants demonstrated learning in faster and/or more accurate responses to high frequency/repeated versus low frequency/novel stimuli. When grouped by DAT1, TLT learning was greater for the 9-repeat carriers than the 10/10 group, despite equal overall accuracy. In contrast, there were no significant group differences in SCCT. Thus, inheritance of the DAT1 9-repeat allele was beneficial for implicit sequence learning, but not implicit spatial contextual learning.

F77

AN ARITHMETICAL TRAINING REGIME MOTIVATED BY PRINCIPLES OF BASAL GANGLIA FUNCTION Arava Y. Kallai[1], Andrea Ponting[1], Christian D. Schunn[1], Julie Fiez[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition, Pittsburgh, PA — We developed an arithmetical training program with the aim of optimally engaging a basal ganglia learning system in order to improve numerical cognition. Hypothesized key features of the training regime were motivated by prior work (e.g., Tricomi et al., 2006), and included the use of trial-specific contingent feedback, performance-based rewards, and uncertainty about trial outcomes. A secondary hypothesis was that engagement of the basal ganglia would induce changes in the horizontal extension of the intraparietal sulcus (hIPS), an area linked to non-symbolic number representation (e.g., Dehaene et al., 2003). Training consisted of five one-hour sessions in which twenty subjects solved addition and subtraction problems. A control group of twenty subjects was trained in numbers typing. All subjects were pre- and post-tested in a variety of tasks related to double-digit number representation. In a number comparison task, accuracy rates were improved for Experimental subjects but not for Control subjects. A marginally significant Automatic Addition Effect (LeFevre et al., 1988) for double-digit numbers was observed for the Experimental group but not for the Control group. In a Stroop-Like task, only Experimental subjects showed a congruity effect (higher accuracy when larger sums were shown in larger versus smaller boxes). We conclude that the training regime leads to more robust and fine-tuned representations of large (double-digit) numbers. Functional magnetic resonance imaging (fMRI) scans were conducted pre- and post-training, and continuing work will explore whether changes of activity in the hIPS region are correlated with behavioral measures of changing numerical representation.

F78

MULTIMODAL PROFILES OF OBJECT CATEGORIES Chris McNorgan[1], Lawrence W. Barsalou[2], Ken McRae[3], Marc F. Joanisse[3]; [1]Northwestern University, [2]Emory University, [3]University of Western Ontario — Our understanding of the neural organization of concept representations has been informed by the category specific deficits patient literature, which has often framed these deficits in terms of impaired knowledge of living versus nonliving things and explained them in terms of impairments to sensory versus functional knowledge or in terms of domain-specific representational systems. Increasingly sophisticated experiments and research tools have revealed unintuitive patterns of category specific deficits at even finer-grained levels that we aimed to explain in terms of the saliency of different sensorimotor knowledge types (Cree & McRae, 2002). Participants categorized color pictures of objects from two living things (animals and fruits/vegetables) and two non-living things (manipulable tools, musical instruments) categories in a fast event-related fMRI paradigm. Pictures appeared either once or three times over the course of the experiment. The salience of each of several knowledge types for each category was predicted from a feature production norms database in both conventional BOLD and fMRI adaptation analyses. The results are interpreted within the framework of a distributed multimodal representational system and suggest that object concept categories can be described in terms of the profile of saliency of different knowledge types.

F79

STRETCHING THE IMPLICIT MUSCLE: A PARAMETRIC STUDY OF PERCEPTUAL-MOTOR SEQUENCE LEARNING USING EXTENDED SEQUENCE LENGTHS Daniel J. Sanchez[1], Paul J. Reber[1]; [1]Northwestern University — Perceptual-motor sequence learning has an extensive research history, but most studies have relied on using short sequences of five to twelve items. Utilizing a new Serial Interception Sequence Learning (SISL) task, the implicit learning of longer motor sequences was examined to explore the limit of information complexity that can be learned in short training sessions. In the SISL task, circular cues scroll vertically towards ring-shaped targets on a computer screen. Participants attempt to press the corresponding key when a cue reaches its target zone. Multiple cues may reach their targets simultaneously. Participants were not told that the cues followed a repeating sequence. To obscure the repetitions, twenty percent of the training trials were in a random order. The velocity of the cues increased as task performance improved to maintain task difficulty. After training, implicit knowledge was assessed by comparing performance for the trained sequence against novel sequences. Training began with 30-item sequences and subsequent groups received successively longer sequence lengths. After the implicit test, participants were informed about the repeating sequence and performed recognition and verbal recall tests. For recognition, participants rated five sequences as to how likely it was that the sequence had been repeated during training. Even with extended-length sequences, participants exhibited sequence-specific learning within an hour of training. A steep decline in recognition performance for sequences exceeding 30 items suggests that implicit memory systems are primarily driving the perceptual-motor sequence learning. These results provide broader insight into the capabilities of the brain regions responsible for implicit learning.

F80

DECREASED BOLD RESPONSE IN A BILATERAL PREMOTOR-OCCIPITAL-PARIETAL NETWORK DURING PERFORMANCE OF A PRACTICED SERIAL INTERCEPTION SEQUENCE Eric W. Gobel[1], Paul J. Reber[1]; [1]Northwestern University — Most well practiced perceptual-motor skills are composed of a learned sequence of movements that must be performed in a particular order with specific, precise timing. Neuroimaging was used to identify the sequence-specific changes in neural activity occurring as a result of experience. Participants initially practiced the Serial Interception Sequence Learning (SISL) task, which emphasizes precise timing of an interception response to a moving visual cue and allows for manipulation of inter-stimulus timing information. After implicitly learning an embedded 12-item repeating sequence, fMRI data were collected while participants performed four transfer conditions, which maintained either the ordinal sequence, the timing sequence, both sequences, or neither sequence. When either the order of actions or the timing intervals between actions was changed, performance dropped to a level equivalent to that of a completely novel sequence. Performance of the practiced sequence was correlated with decreased activity across a bilateral premotor-occipital-parietal network, reflecting sequence-specific facilitation of motor planning, visual motion processing, and spatial relationship analysis. These reductions were not associated with decreases in reaction time since learning in the SISL task is reflected in increased accuracy of interception responses. Maintaining only the timing sequence increased activity in the same network, which may reflect interference of the random ordinal information during a practiced temporal pattern. These results show tight integration of timing and order information in a learned sequence, associated with decreased activity in a distributed cortical network of brain regions involved in the task.

F81

PROBABILISTIC CLASSIFICATION LEARNING WITH FEEDBACK IS ASSOCIATED WITH DOPAMINE RELEASE IN THE VENTRAL STRIATUM-EVIDENCE FROM A 11C-RACLOPRIDE PET STUDY Leonora Wilkinson[1], Yen Tai[2], Paola Piccini[2], Marjan Jahanshahi[3]; [1]Brain Stimulation Unit, National Institute of Neurological Disorders and Stroke, Bethesda, MD, [2]Division of Neurosciences and Mental Health, MRC Cyclotron Building, Faculty of Medicine, Imperial College, London, UK, [3]Sobell Department of Motor Neuroscience and Movement Disorders, Institute of Neurology, University College London, London, UK — Functional neuroimaging has shown that probabilistic classification learning during the weather prediction task (WPT) recruits the cortico-striatal circuits. Patients with Parkinson's disease have dopamine depletion in the striatum and are impaired on WPT learning. It has been proposed that the role of the striatum and dopaminergic projections is to process corrective feedback during WPT learning. The present study used 11C- raclopride PET to measure striatal dopamine release in healthy participants during WPT learning with or without corrective feedback. 15 participants were assigned to one of two groups who completed 400 trials of the WPT either with (n = 7) or without (n = 8) corrective feedback, while having a 11C-raclopride PET scan. In addition, all participants completed a control task while having a 11C-raclopride scan. The order of WPT and control scans was counterbalanced. Significantly more endogenous dopamine was released in the ventral striatum during WPT learning with feedback compared to WPT learning without feedback. Such task-dependent release of dopamine was not observed for the dorsal striatum. The findings establish, for the first time, ventral striatal dopaminergic contribution to probabilistic classification learning with feedback on the WPT.

F82

SLEEP-DEPENDENT CONSOLIDATION OF STATISTICAL LEARNING Simon Durrant[1], Penny Lewis[1,2]; [1]School of Psychological Sciences, University of Manchester, [2]Institute of Cognitive Neuroscience, University College London — The consolidation of memory during sleep has been increasingly documented in the last decade. Perceptual learning, and in particular the important field of exposure learning, is currently under-represented in this research. Here, we evaluate the contribution of sleep to the offline consolidation of higher-order statistical patterns. Participants were exposed to a 7 minute stream of 5 pure tones generated stochastically from a transition matrix specifying a particular second-order transition structure while eliminating significant first-order and zero-order transition information. Following the exposure period, participants were presented with 84 two-alternative-forced-choice (2AFC) trials in which each trial contained one sequence generated using the same transition matrix as the exposure stream and one random sequence. Subjects indicated which sequence was familiar. 12hrs after the first session, participants were retested with 84 more 2AFC stimuli. 24 participants were divided equally between Wake and Sleep groups, with the Wake group trained at 8am and retested at 8pm on the same day and the Sleep group at trained at 8pm and retested at 8am the following morning. Comparison of sessions 1 and 2 revealed that the Sleep group improved by 7.5% between test sessions (t-test; p=0.0025), but showed no improvement for the Wake group (t-test; p=0.901). There were no between group differences in performance on the first session (p=0.984), or in performance on evening sessions (p=0.985), ruling out circadian factors. This result extends recent observations of enhanced abstraction and integration after overnight retention intervals by demonstrating that the representation of statistical patterns is also strengthened across sleep.

F83

STRUCTURAL CORRELATES OF SENSORIMOTOR SYNCHRONISATION ON A SEQUENCE LEARNING TASK Christopher J. Steele[1], Jan Scholz[2], Heidi Johansen-Berg[2], Virginia B. Penhune[1]; [1]Concordia University, Montreal, QC, Canada, [2]Oxford Centre for Functional MRI of the Brain, Oxford University, UK — The precise synchronisation of actions to external events is a fundamental component of motor behaviour. This experiment utilised five days of training on a visual synchronisation task to probe the structural correlates of synchronisation. Subjects reproduced a sequence of precisely timed finger taps in synchrony with a visual stimulus; they received explicit training at the beginning of the first day, then performed three runs (48 trials). Three runs were conducted on each consecutive day; DTI and T1-weighted structural scans were acquired at the end of Day 5 and correlated with synchronisation performance. Synchronisation was negatively correlated with FA throughout a region of overlap between the corticospinal tract (CST) and superior longitudinal fasciculus. Further analyses revealed that the effect was related to individual differences in perpendicular, rather than parallel, diffusivity. Tractography confirmed that this fibre connected superiorly/posteriorly to sensorimotor and superior parietal cortex, and to the putamen and frontal lobe via the external capsule. This negative correlation may be due to greater integrity in fibres crossing the CST in those who synchronise better; thus, synchronisation may involve more than just primary motor regions. VBM analyses showed that the rate of improvement in synchronisation over the experiment was positively correlated with two regions of cerebellar cortex: ipsilateral VI and medial V. These regions may reflect either an enhanced internal representation of the skill or greater volume devoted to error-feedback. We successfully exploited individual differences in brain structure to identify regions that contribute to skilled performance and learning on a sensorimotor synchronisation task.

F84

GENERAL IMPROVEMENTS IN MATHEMATICAL ABILITY VIA A BASAL GANGLIA LEARNING MECHANISM Andrea Ponting[1,2], Arava Y. Kallai[1], Christian D. Schunn[1], Julie Fiez[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition, Pittsburgh, PA — We developed an arithmetical training program aimed at optimally engaging a basal ganglia learning system and improving numerical cognition. Hypothesized key features were motivated by previous work (e.g., Tricomi et al., 2006), and included trial-specific contingent feedback, performance-based rewards, and uncertainty about trial outcomes. Training consisted of five one-hour meetings in which twenty subjects (experimental group) solved addition and subtraction problems and twenty (control group) were trained to type digits. All subjects were pre- and post-tested using behavioral and imaging tasks aimed at measuring mathematical proficiency. Experimental subjects showed dramatic improvements in performance over the course of training, with 18 of 20 subjects learning to accurately compute the sum or difference of double-digit/double-digit problems within a 3.5 second response window. In a task involving double-digit addition and subtraction problems, larger pre-post gains were seen for experimental subjects compared to control subjects, yet no differences were seen between new and old problems, showing that gains were not based on retrieval. Also, a pre-post assessment of single-digit math fact retrieval showed greater gains for addition problems in experimental than control subjects. In a math SAT-like test, experimental subjects showed greater pre-post gains over control subjects, providing evidence of transfer benefits to complex mathematical cognition. We conclude that training with contingent feedback, high incentive, and uncertainty, leads to broad benefits beyond the exact training task, including more basic fact retrieval and complex mathematical proficiency. Pilot neuroimaging results suggest that these changes are mediated by a basal ganglia learning system.

F85

WHITE MATTER INTEGRITY CORRELATES OF IMPLICIT SEQUENCE LEARNING IN HEALTHY AGING Ilana J. Bennett[1], David J. Madden[2], Chandan J. Vaidya[1,3], James H. Howard Jr.[1,4], Darlene V. Howard[1]; [1]Georgetown University, [2]Duke University Medical Center, [3]Children's National Medical Center, [4]Catholic University of America — Implicit sequence learning refers to improved performance to predictable, frequently occurring events within repeating sequence, without explicit awareness of the sequential regularity. Previous research has identified subcortical (caudate, putamen, hippocampus) and cortical (dorsolateral prefrontal cortex, DLPFC; supplementary motor area, SMA) regions involved in implicit sequence learning. However, evidence is less clear regarding whether these neural substrates differ with aging. The present study used diffusion tensor imaging (DTI) tractography to reconstruct white matter connections among the known gray matter substrates of implicit sequence learning. Integrity of these tracts was then related to learning in the alternating serial reaction time task (ASRT) in 14 younger (18.9 ± 0.7 years old, 9 female) and 14 healthy older adults (67.6 ± 3.1 years old, 63-72 years, 10 female). Both age groups showed significant sequence learning (better performance to high versus low frequent events), with an age-related difference in the late learning stage. Caudate-DLPFC and hippocampus-DLPFC tract integrity were related to ASRT sequence learning, which may reflect their role in forming sequence-specific associations, and these brain-behavior relationships did not differ significantly between age groups. In contrast, putamen-SMA tract integrity was not significantly related to ASRT sequence learning, which may reflect this network being involved in non-sequence-specific response selection and execution. Additionally, individual differences in caudate-DLPFC tract integrity mediated the age-related decline in late stage sequence learning. Together, these findings complement studies of gray matter substrates underlying implicit sequence learning, and provide evidence for similar white matter integrity-sequence learning relationships in younger and healthy older adults.

F86

CONTEXTUAL INTERFERENCE BENEFITS IN MOTOR SEQUENCE LEARNING ARE ACCOMPANIED BY INCREASED INTRACORTICAL EXCITABILITY IN MOTOR CORTEX Chien-Ho Lin[1], Barbara Knowlton[1], Allan Wu[1]; [1]Neurology, UCLA — Generally, practice of different tasks in a random order induces superior retention compared to practicing in a blocked order, a phenomenon known as the contextual-interference (CI) effect. We applied paired-pulse transcranial magnetic stimulation (TMS) to investigate if the CI benefit in behavioral performance is associated with changes in intracortical inhibition (SICI) and facilitation (ICF). 10 adults practiced serial reaction time tasks where a set of three 4-element sequences were arranged in blocks or in a random order on 2 successive days. On Day 5th, subjects were tested with practiced sequences to evaluate learning. Subjects practiced sequences in both blocked and random conditions in separate sessions 2-4 weeks apart. TMS was applied over primary motor cortex (M1) as paired subthreshold-suprathreshold TMS pulses separated by interstimulus intervals of 2 (SICI) and 10 msec (ICF). We identified a CI effect in that while reaction times (RT) in the random condition were slower than the blocked condition during practice (effect size (ES)= 0.8) the reverse was true during retention on Day 5, with faster RT for sequences practiced under random conditions (ES= 0.9). Between Day 1 and Day 5, SICI and ICF both showed increased excitability after random practice, but not after blocked practice (ES of ICF: YR= 0.9, YB= -0.1; of SICI: YR= 0.7, YB= -0.6). These results suggest that the CI effect can be demonstrated in a within-subject design. Results also suggest that random practice is accompanied by increased intracortical excitability within M1 which may support the superior retention of practiced sequences.

F87

IMPAIRMENT OF HIGHER-ORDER BUT NOT SIMPLE SEQUENCE LEARNING IN A CASE OF BILATERAL HIPPOCAMPAL ORGANIC AMNESIA Clive R. Rosenthal[1], Anne M. Aimola Davies[1], Michael R. Johnson[2], Jerome J. Maller[3], Claire Cochrane[1], Christopher Kennard[1]; [1]University of Oxford, [2]Imperial College London, [3]Monash University — An important conceptual distinction within learning and memory is between knowledge associated with and without complex relational information. When assessed within a neurocognitive framework, a central issue is whether or not the hippocampus is sensitive to the presence or absence of relational information or consciousness, per se. One view is that the hippocampus mediates conscious learning and memory, whereas an alternative position is that the hippocampus is sensitive to the presence of relational information. We examined the ability of a patient with bilateral hippocampal organic amnesia and control participants to learn simple (first-order) and complex (second- and third-order conditional) sequence information on the serial reaction time task. A full assessment using standardised neuropsychological tests indicated the patient's performance was average to high-average ability, even on memory tests such as the WMS-III, Doors and People, and California Verbal Learning. Results from manual volumetry and voxel-based morphometry revealed that the patient had normalised MTL sub-region volumes similar to age-matched controls, whereas T2 and T2-FLAIR magnetic resonance imaging revealed bilateral hyperintense signal in the hippocampi. Sequence knowledge and awareness were assessed on an awareness questionnaire, cued-generation task, and recognition test. Comparison between patient and controls revealed intact learning and recognition of first-order sequences, whereas the patient was impaired on learning second- and third-order sequences, independently of the state of awareness associated with acquired knowledge. These data support the view that the hippocampus mediates relational, rather than conscious, learning per se.

F88

ON THE DEVELOPMENT OF AUTOMATICITY IN RULE-BASED CATEGORIZATION: AN FMRI STUDY Sebastien Helie[1], Jessica Roeder[1], Kyle Liban[1], Sarah Kaufman[1], Billy Bruno[1], F. Gregory Ashby[1]; [1]University of California, Santa Barbara — Sixteen participants were each trained for 20 sessions (over 10,000 trials) in a rule-based categorization task with one of two different underlying category structures. Stimuli were Gabor patterns that varied across trials in spatial frequency, which was the relevant dimension, and orientation, which was always irrelevant. On each trial, participants assigned the single stimulus to one of two categories. In one condition the category structure was simple (low spatial frequencies were in one category, high frequencies in the other). In the other condition, the category structure was more complex (low and high frequencies were in one category, intermediate frequencies in the other). Sessions 1, 4, 10, and 20 were performed in a 3T Siemens fMRI scanner. Asymptotic accuracy (~95% correct) was reached in the first session for the simple categories, and in the third session for the complex categories. The behavioral data (accuracy and reaction times) of the two groups were identical after the third session. Whole brain cluster analysis was performed on Group Maps using FSL (2 Groups x 4 Sessions = 8 Group Maps). The results show a general decrease in the number of clusters with the development of automaticity, thus suggesting more focused brain activation. More precisely, activation in the medial temporal lobes and striatum decreased with practice in both groups. Conversely, activation in the parietal and premotor cortices increased with practice (also in both groups). These changes are consistent with the recent proposal of a computational model of automaticity in rule-guided behavior (Helie & Ashby, 2009).

F89

MEMORY FOR TOOL ATTRIBUTES, MOTOR SKILLS, AND SKILLED TOOL USE: THE ROLE OF DECLARATIVE AND PROCEDURAL MEMORY SYSTEMS Shumita Roy[1], Norman W. Park[1,2]; [1]York University, [2]Kunin-Lunenfeld Applied Research Unit, Baycrest Centre for Geriatric Care — Objective: Previous research has shown that the ability to use tools requires memory. It has also been proposed that different components of tool knowledge rely on different memory systems. For instance, tool attributes (e.g., tool function, colour) have been shown to be represented within the declarative memory system. In contrast, motor skill learning has been shown to be mediated by the procedural memory system. However, the memory representation of skilled tool use (i.e., intentional use of tools) is still unclear. While the importance of procedural memory in skilled tool use is well-established, the necessity of declarative memory is under debate. In this study we propose that skilled tool use relies on an integration of both declarative and procedural memory systems. Method: D.A., an individual with hippocampal amnesia, was trained and tested on various aspects of knowledge related to ten novel tools that were created for this study. D.A.'s performance was compared to that of six age-matched controls. Results: D.A. was unimpaired in motor skill acquisition. Specifically, he became faster in using the tools across training trials. In contrast, D.A. was impaired in recall of tool attributes. Results also showed that D.A. was impaired in skilled tool use. Conclusion: Consistent with previous research, these findings suggest that motor skills are acquired procedurally while tool attributes are represented declaratively. They also suggest that efficient skilled tool use relies on both procedural and declarative memory systems where declarative memory may provide contextual information necessary for the expression of appropriate motor skills.

Executive Processes: Monitoring & Inhibitory Control

F90

SEROTONIN TRANSPORTER POLYMORPHISMS INFLUENCE INHIBITORY CONTROL IN HEALTHY SUBJECTS Nils Inge Landrø[1], Martin Aker[1], Anne Marie Hoel[1], Rune Jonassen[1], Runa Marie Grimholt[2], Kari Bente Foss Haug[2], Alexander Neumeister[3], Tore Charles Stiles[4], Pia Lyche[1]; [1]Center for the Study of Human Cognition, University of Oslo, Oslo, Norway, [2]Ullevål University Hospital, Oslo, Norway, [3]Yale University School of Medicine, West Haven, Connecticut, [4]Norwegian University of Science and Technology, Norway — The serotonin transporter (5-HTTLPR) short allele has reduced transcriptional efficiency compared to the long allele, and individuals carrying the short allele tend to have increased risk for depression. There are also genotype-related alterations in an amygdala-cingulate feedback circuit which is critical for emotion regulation. The cognitive mechanisms and pathways underlying these associations are, however, incompletely understood. Serotonin is also related to impulsivity/inhibitory control, but studies relating 5-HTTLPR to laboratory measures of inhibitory control are lacking. The aim was to investigate possible links between serotonin transporter polymorphisms (5-HTTLPR) and inhibitory control. Eighthy seven healthy adults, screened for psychopathology applying SCID I and SCID II, were included. A triallelic classification was reclassified into a biallelic model based on the level of 5-HTT gene expression. Inhibitory control was measured with the Stop Signal Task (SST) from the CANTAB. Participants are programmed to a choice reaction to a stimulus, and inhibitory control is defined as the subject's ability to inhibit the prepotent motor response. Analyses of variance showed a statistically significant effect of genotype on inhibition. Subjects carrying the low expressive alleles (S and Lg)were slower to complete the process of inhibiting a preprogrammed response than subjects with two long (L) alleles. These results suggest that S and Lg alleles constitute vulnerabilities for impaired inhibition, forming a possible cognitive endophenotype in disorders like depression.

Executive Processes: Other

F91

POLYMORPHISM OF DOPAMINE TRANSPORTER PROTEIN GENE INFLUENCES SUBSTANTIA NIGRA FRACTIONAL ANISOTROPY: A DIFFUSION TENSOR IMAGING STUDY Arianne Johnson[1], Angela Chen[1], Michael Miller[1], Skirmantas Janusonis[1], Scott Grafton[1]; [1]University of California, Santa Barbara — Previous studies have shown that there are significant differences in fractional anisotropy (FA) values in the substantia nigra of clinical populations, such as de novo Parkinson's patients, relative to healthy controls. This likely represents changes of cellular structure from neurodegeneration. In the present study, it was hypothesized that variation in FA values might also occur in normal subjects, differentiated by genetic markers of neurotransmission. To test this, differences of FA values in the substantia nigra (SN), a region known to have a high density of dopaminergic cells, were compared as a function of dopamine transporter (DAT) genotype in 81 subjects. FA values were generated from 30-directional diffusion tensor imaging on a 3T Siemens scanner. Structural T1, FA and b0 scans were used to create unbiased regions of interest for FA extraction, blinded to genetic status. DAT allele had a significant effect on caudal SN FA ($p = .044$). Specifically, the 9/9 genotype group had a higher mean FA value than the 9/10 genotype group. Our in vivo results show that normal genetic variation of brainstem dopamine influences brainstem FA values, which might represent neurotransmitter site-specific changes in cell structure. Dopamine status is associated with human cognitive performance and psychiatric disease. The current results demonstrate that FA may be used as a potential biomarker for this status.

Thinking: Other

F92

VAL ALLELE LOAD AT BDNF VAL66MET PREDICTS VERBAL INTELLIGENCE Adam Green[1], Colin DeYoung[2], John Fossella[3], Elena Grigorenka[1], Jeremy Gray[1]; [1]Yale University, [2]University of Minnesota, [3]Mount Sinai School of Medicine — Genetic factors contributing to verbal intelligence among healthy individuals have not been well characterized. The gene encoding Brain-Derived Neurotrophic Growth Factor (BDNF) is a likely candidate because BDNF contributes to strengthening white matter connections between brain regions thought to act cooperatively in language and higher cognitive function. Here, we found that Valine allele load at a functional polymorphism within the BDNF gene (BDNF Val66Met) predicted verbal intelligence, assessed using a latent variable derived from standard verbal measures, in a cohort of 410 healthy participants. 175 of the genotyped participants underwent structural and functional MRI. Neural endophenotypes likely to mediate the BDNF-verbal intelligence relationship are indicated.

Thinking: Problem Solving

F93

OVARIAN CYCLE EFFECTS ON IMMEDIATE REWARD BIAS: A WINDOW ON PFC DOPAMINE Christopher Smith[1], Charlotte Boettiger[1,2,3]; [1]Curriculum in Neurobiology, University of North Carolina at Chapel Hill, [2]Bowles Center for Alcohol Studies, UNC-CH, [3]Biomedical Imaging Research Center, UNC-CH — Neuroimaging data from our lab indicate a role for the dorsal prefrontal cortex (dPFC) in immediate reward bias. Specifically, when subjects choose between hypothetical monetary rewards: one available "today" (Now) and another, larger reward available at one of several delays (Later), those showing hyperactivity in the dPFC more often choose Now over Later, quantified as an impulsive choice ratio (ICR). Higher ICRs and greater dPFC activity are also observed in individuals with the Val/Val genotype at the catechol-O-methyltransferase (COMT) Val158Met polymorphism, associated with reduced cortical DA. In the present study, we investigated the role of dopamine in influencing ICR by taking advantage of the fluctuation in estrogen levels across the menstrual cycle, as previous research indicates that estrogen increases dopamine transmission. We tested adult females in a within subjects design at peak (day 11-12) and trough (day 1-2) estrogen levels. A significant effect of cycle day ($t(45)=2.52$, $p<0.05$) was found in COMT 158Val carriers, with ICR decreasing during elevated estrogen. These data suggest that ICR may not be a fixed trait, but one that can be manipulated by transient changes in putative frontal dopamine. Moreover, results from a concurrent study in our lab prompted testing for differences between late adolescents (ages 18-21; n=26) and adults (ages 22-40; n=27), revealing that, among 158Val carriers, late adolescents demonstrate significantly higher ICRs than adults ($F(1, 46)=4.79$, $p<0.05$). These results suggest that delayed maturation of frontal structures engaged by this task may contribute to heightened IRB and that such effects may be COMT genotype-dependent.

Executive Processes: Monitoring & Inhibitory Control

F94

THE DEVELOPMENT OF INTERFERENCE CONTROL Clare Killikelly[1], Denes Szucs[1]; [1]University of Cambridge — Previous research has identified that younger children are more susceptible to distracting stimuli than adults. Interference control or the ability to resist interference from distracting stimuli is a skill that develops throughout childhood. The cognitive and motor components that underlie the development of interference control have yet to be systematically documented. The current study attempts to separate the contributions of cognitive and motor response related processes involved in interference control in two ways. Firstly an amended colour word Stroop paradigm was used to target cognitive and motor related processes more precisely by using three different conditions that engage cognitive and motor control to different degrees. Secondly this research examined the underlying biomarkers of the cognitive and motor processes. Electroencephalography (EEG) was used to examine the cognitive level of processing whereas electromyography (EMG) was used to examine the response level of processing. This study confirmed that the cognitive and motor processes involved in interference control can be dissociated in the manual colour word Stroop paradigm. Compared to trials requiring cognitive control participants were slowest on the trials where the ability to engage motor control was required. This indicates that motor interference control is perhaps a slower and more difficult exercise. An underlying marker of cognitive control was also determined. The ERP analysis revealed that at 400ms there is an amplitude decrease in the conditions with cognitive interference. This amplitude modulation is thought to be related to conflict detection and the implementation of interference control at the cognitive level.

F95

THE EFFECTS OF STIMULUS AMBIGUITY ON CONFLICT MONITORING: FRONTAL N2 MODULATION IN A VISUAL ODDBALL TASK John Fedota[1], Craig McDonald[1], Raja Parasuraman[1]; [1]George Mason University — Prior evidence suggests ERP components such as frontal N2 are illustrative of conflict monitoring at the response stage of information processing. However, recent evidence using go/nogo tasks has shown perceptual similarity can elicit frontal N2 modulations as well. This suggests that stimulus ambiguity may modulate ERP signs of response conflict. The present study manipulated stimulus ambiguity and observed the subsequent modulations on frontal N2 in a visual oddball task. The use of an oddball paradigm should reduce the influence of prepotent response tendencies on conflict monitoring. The perceptual ambiguity of the nogo stimuli was modulated in two conditions. In the hard condition, go and nogo stimuli were perceptually similar, whereas in the easy condition, go and nogo stimuli were perceptually different. The differences between stimuli were determined using a JND protocol in an effort to create maximum stimulus ambiguity. Behavioral results showed that subjects were able to make a stimulus discrimination in the hard condition. Frontal N2 amplitude was unchanged for go stimuli in both conditions of the oddball tasks. However, in the hard task the perceptually similar nogo stimuli elicited a larger frontal N2 than did nogo stimuli in the easy task. These results show that high stimulus ambiguity can modulate frontal N2 in a visual oddball task. This suggests that conflict elicited early in the information processing cascade can, under optimal conditions, modulate ERP components associated primarily with response conflict monitoring. However, this conflict processing is most prominent with frequent nogo stimulus presentation in difficult perceptual discriminations.

F96

WIDE AWAKE AND IN CONTROL: CAFFEINE AND THE EXECUTIVE CONTROL OF ATTENTION Tad Brunye[1,2], Caroline Mahoney[1,2], Harris Lieberman[3], Holly Taylor[2]; [1]US Army, Natick Research, Development and Engineering Center, [2]Tufts University, [3]US Army, Research Institute of Environmental Medicine — The present work investigated the effects of caffeine (0 mg, 100 mg, 200 mg, 400 mg) on the attention network test (ANT), a modified flanker task designed to test three visual attention network functions: alerting, orienting, and executive control. In a placebo-controlled, double-blind study using a repeated-measures design, we found that the effects of caffeine on visual attention vary as a function of dose and the attention network under examination. Caffeine improved alerting and executive control function in a dose-response manner, asymptoting at 200 mg. These results are congruent with caffeine's effects on adenosine-mediated dopaminergic activity in the thalamus, prefrontal cortex and anterior cingulate, and the involvement of these areas in maintaining vigilance and controlling attention. Higher doses of caffeine also led to a marginally less efficient allocation of visual attention towards cued regions during task performance (i.e., orienting). Taken together, results of this study demonstrate that caffeine has differential effects on visual attention networks as a function of dose, and such effects have implications for hypothesized interactions of caffeine, adenosine and dopamine in brain areas mediating visual attention.

F97

ACC ACTIVITY AND PUNISHMENT SENSITIVITY: COMPARING ADOLESCENTS AND ADULTS DURING A MONETARY FEEDBACK TASK Diane Santesso[1], Angela Dzyundzyak[1], Sidney Segalowitz[1]; [1]Brock University — The triadic model of motivated behavior proposes that adolescents might be biased toward taking risks and disregarding negative consequences of their actions due to immaturity of medial prefrontal cortex, including the anterior cingulate cortex (ACC), in regulating striatal reward-drives. According to this model, adolescents should be happier when winning and less upset when losing money compared to adults. The purpose of the present study was to examine such ACC-related activity in adolescents and adults. Thirty adults and twenty adolescents completed a self-report measure of sensitivity to punishment/reward and performed an ERP monetary feedback task. The feedback-related negativity (FRN) and LORETA current source density were used to index ACC activity. Despite no developmental differences on the task, LORETA source estimation revealed that losing was associated with greater activity in the ACC compared to winning money. Higher sensitivity to punishment was related to greater activity in the ACC, but this effect was driven by adults. No significant relations were found between sensitivity to punishment or reward for winning for either age group. Results are consistent with other studies underscoring the role of the ACC in negative feedback processing and provide some support for the triadic model. Importantly, higher sensitivity to losses in adults may provide important clues to understanding adolescents' risky behaviors and/or adults' greater cautiousness.

F98

WHAT COGNITIVE PROCESSES CONTRIBUTE TO THE DEVELOPMENT OF INHIBITORY CONTROL IN CHILDHOOD? AN ELECTROENCEPHALOGRAPHY (EEG) STUDY IN YOUNG CHILDREN AND ADULTS Donna Bryce[1], Denes Szucs[1], Fruzsina Soltesz[1], David Whitebread[1]; [1]University of Cambridge — Inhibitory control, the ability to suppress behaviour when it is inappropriate, is a crucial executive skill. Variations of the classic Stroop task have established that the performance difference between congruent and incongruent conditions decreases throughout childhood, demonstrating improved inhibitory control. This study aims to more precisely establish what cognitive processes are reflected in this developmental improvement. That is, success on incongruent trials in a Stroop task depends upon controlling both ‘early’ perceptual/cognitive conflict and ‘late’ motor conflict; behavioural studies only assess the amalgamation of these processes. Elaborating upon our previous study, we have EEG data from three groups of participants aged approximately 5-years, 7-years, and 27-years. They completed an Animal Stroop task, where two animals of different ‘real life’ sizes are presented on-screen in images that are also physically different sizes. The participant must choose which animal is larger in real life. Two factors are manipulated in this task: congruency and size difference (large, where small/big animal pairings are presented vs. small, where small/medium and medium/big animal pairings are presented). The lateralised readiness potential (LRP) reflects response preparation before muscle contractions begin and in the absence of an overt response. Examination of the LRP in different age-groups suggests that younger children have a greater initial incorrect activation to overcome, which could partly account for the difference in reaction time. A point-by-point repeated-measures ANOVA of ERP amplitude data indicates that the LRP and RT age effects can be attributed to developing inhibitory control rather than speed of processing differences.

F99

NEURAL CORRELATES OF INHIBITION OF PROACTIVE INTERFERENCE FROM COGNITIVE SET Seiki Konishi[1], Koji Jimura[1], Junichi Chikazoe[1], Satoshi Hirose[1], Takamitsu Watanabe[1], Hiroko Kimura[1], Yasushi Miyashita[1]; [1]The University of Tokyo School of Medicine — The prefrontal cortical mechanisms for inhibition of proactive interference (PI) have been reported that are recruited long after one behavior is updated to another. However, very little is known about the inhibitory mechanisms that are recruited immediately after the update. The WCST was modified in the present fMRI study such that inhibition of PI could be examined both immediately after and long after update of behavior. Use of 'dual-match' stimuli allowed us to compare two types of trials where inhibition of PI was and was not required (Control and Release trials, respectively). Prominent activation was observed in the left presupplementary motor area (pre-SMA) during Control vs. Release trials. The pre-SMA activation was selective to PI inhibition required immediate after update of behavior, which exhibited marked contrast to the left anterior prefrontal activation selective to PI inhibition required long after the update. These results reveal dissociable inhibitory mechanisms in these two regions that are recruited in the different temporal contexts of the inhibitory demands imposed during performance of the task.

F100

AN FMRI STUDY ON THE ROLE OF UNCERTAINTY AND SPURIOUS FEEDBACK IN CORRECTING SUBSEQUENT PERFORMANCE Sharon Morein-Zamir[1], Chris Dodds[1], Barbara Sahakian[1], Trevor Robbins[1]; [1]University of Cambridge — Abnormal monitoring is believed to play a key role in a number of neuropsychiatric disorders such as depression, Obsessive Compulsive Disorder and Attention Deficit Hyperactivity Disorder. We examined event-related fMRI activations in 18 healthy participants during an action monitoring task. Participants performed a simple visual discrimination in pairs of trials, deciding whether a masked target was a 'T' or an 'L'. High uncertainty was maintained by titrating the duration of the target stimulus. Following the first response, participants received spurious feedback independent of their performance, and then responded again to the same stimulus presentation. While performance during the first presentation did not differ from chance, slower responses likely representing increased uncertainty, were associated with increased activation in the medial prefrontal cortex as well as right insula and inferior parietal lobe bilaterally. On the second presentation, participants were more likely to switch following negative feedback and following erroneous performance on the first presentation, with no interaction between the two factors on behaviour. Individual self-reported levels of meta-cognitive self-consciousness and meta-cognitive negative beliefs as well as trait anxiety correlated positively with the likelihood to switch response despite being correct in the first presentation and receiving positive feedback. Response adjustment (i.e., switching response on the second presentation) compared to maintaining the same response was associated with extensive activity in the medial prefrontal cortex and insula bilaterally. These data suggest that areas previously implicated in monitoring errors whilst and immediately after they occur, are also involved in adjustment or perceived correction of subsequent behaviour.

F101

ERROR AND CONFLICT RELATED BRAIN REGIONS AT TASK AND RESPONSE LEVEL Charlotte Desmet[1], Wim Fias[1], Marcel Brass[1]; [1]Ghent University, Ghent, Belgium — Most studies investigating adaptive behavior have focused on errors and conflict at the response level. Under these situations the rostral cingulate zone seems to be activated. In this study we investigated if task errors (= performing the wrong task) and task conflict also activate these brain regions. Our results indicate that both task and response errors activate medial prefrontal regions. Although there seems to be an overlap between both error regions, response errors extend more ventral to the rostral cingulate zone while the region associated with task errors extend more dorsal to the dorsal frontomedian cortex. On the other hand, a clear dissociation was perceived between areas associated with response conflict and with task conflict. While response conflict was correlated with the rostral cingulate zone, the left inferior frontal junction, the right middle frontal gyrus and the left frontomarginal sulcus, task conflict was correlated with the pre-sma, the premotor cortex and the right middle frontal gyrus.

F102

IMPAIRED RESPONSE INHIBITION IN ILL GULF WAR VETERANS Gail D. Tillman[1], Timothy A. Green[1], Thomas C. Ferree[2], Clifford S. Calley[1], Mandy J. Maguire[1], John Hart Jr.[1], Robert W. Haley[2], Michael A. Kraut[3]; [1]The University of Texas at Dallas, [2]The University of Texas Southwestern Medical Center, [3]The Johns Hopkins University School of Medicine — Poor performance on tasks implicating inhibitory dysfunction has been observed among chronically ill veterans of the 1991 Persian Gulf War. Semantic difficulties such as word-finding have also been frequently reported. We collected event-related potential (ERP) and behavioral data from 10 veterans who met Haley criteria for Gulf War Syndrome 2 and from 11 matched Gulf War veteran controls who were deployed but not symptomatic while they performed a GO-NOGO task. This task required a button-push response when the line drawing was of an object but a withheld response when the drawing was of an animal. Thus, both semantic processing and inhibitory processing were required. Behavioral data showed a significantly greater false-alarm rate among the ill veterans. This was accompanied in the ERP data by significantly reduced amplitude in the NOGO P3 of the ill group, which is consistent with previous studies of other patient groups that have shown poor inhibitory response performance to be marked by a blunted or absent NOGO P3. Analysis of the ERP showed no differences in the N2 amplitudes. Given previous studies associating the N2 with differentiation of stimuli at a semantic level, this supported the contention that Syndrome 2 veterans' deficit lies more in inhibition ability than in detection of semantic differences in the stimuli.

F103

A HIERARCHICAL BAYESIAN MODEL OF THE STOP-SIGNAL TASK: RELATION TO CORTICOSTRIATAL MODEL Thomas Wiecki[1], Michael Frank[1]; [1]Brown University — The stop-signal task has been used extensively by cognitive neuroscientists to research response inhibition. In this task, subjects have to respond to a Go-signal as fast as possible. On a minority of trials, however, a Stop-signal is presented after a variable delay following the Go-signal, instructing the subject to withhold their response. The widely used "horse-race" model assumes a race between a Go and a Stop-process. While the speed of the Go-process can be measured, the speed of the Stop-process can only be estimated by analyzing inhibition performance at various Stop-signal delays. The horse-race model assumes the Stop process to have fixed speed. Recent data along with computational simulations, however, challenge the assumption of a fixed length process. Rather, the Stop-process appears to be dynamically influenced by factors like motivation and saliency, which the horse-race model cannot currently dissociate. We extended our model of the basal ganglia to simulate the stop-signal task, and showed that it can account for various lesion and pharmacological data. But while this model makes contact with neural mechanisms underlying response inhibition, it is complex and has too many parameters to quantitatively fit individual human subject data. We thus applied Markov-Chain Monte-Carlo techniques to estimate the parameters of a hierarchical bayesian model governing subject choices. We estimate the speed of the Stop process, motivational biases and salience detection rates by fitting them to response time distributions and stopping patterns. We benchmark the model by fitting it to data generated by our neural model of response inhibition.

F104

HE'S A CHIP OFF THE OLD BLOCK: PERFORMANCE MONITORING ALTERATIONS IN PATIENTS WITH OBSESSIVE-COMPULSIVE DISORDER AND UNAFFECTED FIRST-DEGREE RELATIVES Anja Riesel[1], Tanja Endrass[1], Christian Kaufmann[1], Norbert Kathmann[1]; [1]Humboldt University, Berlin — Performance monitoring dysfunctions have been repeatedly associated with obsessive-compulsive disorder (OCD). Event-related brain potentials (ERP) and functional magnetic resonance imaging (fMRI) studies consistently showed increased error-related brain activity in patients with OCD. Enhanced electrophysiological correlates of performance monitoring (ERN, error-related negativity and CRN, correct-related negativity) are associated with OCD and seem to be independent from state-related changes in OCD symptoms. Therefore, they are considered as a potential endophenotype marker of OCD. Hence, the aim of the present study was to examine whether unaffected first-degree relatives of OCD patients show larger ERN amplitudes and larger amplitudes of the CRN. ERPs were recorded from unaffected first-degree relatives of OCD patients, OCD patients and healthy controls while performing a modified flanker task. Results indicate enhanced ERN and CRN amplitudes in first-degree relatives and OCD patients compared to healthy controls. These results indicate that performance monitoring dysfunctions are not only observed in OCD patients but also in a group of unaffected first-degree relatives. Thus, overactive performance monitoring could represent a potential neurocognitive endophenotype in OCD mediating the familial or genetic vulnerability for OCD.

F105

EFFECTS OF SELF-RELEVANT FAILURE ON PERFORMANCE MONITORING: AN ELECTROPHYSIOLOGICAL INVESTIGATION Kerstin Unger[1,2], Jutta Kray[1,2], Axel Mecklinger[1,2]; [1]Saarland University, Saarbruecken, Germany, [2]International Research Training Group "Adaptive Minds" — A growing body of evidence indicates that motivational and affective variables modulate the amplitude of the error-related negativity (ERN/Ne), suggesting that this component does not only reflect cognitive facets of error processing. This study examined the impact of self-relevant failure on earlier and later stages of performance monitoring in a reinforcement learning task. EEG was recorded while participants engaged in two consecutive phases of a probabilistic learning task, in which we manipulated the validity of feedback. After the first learning phase, participants performed a visual search task. To induce self-relevance it was described as diagnostic of intellectual abilities. Participants were assigned to one of two groups receiving either no feedback or strong negative feedback during the visual search task. Results indicated a clear dissociation between learning-related behavioural and electrophysiological effects for both groups in the second learning phase. For the no-feedback group ERN/Ne amplitude decreased from first to second half of learning, while performance remained stable across the two learning phases. In contrast, the failure-feedback group showed a smaller ERN/Ne magnitude than the no-feedback group during the first half of the second learning phase. However, in this group error rate and ERN/Ne amplitude increased during the second half of the learning phase following failure induction. This pattern of results suggests that failure experience has a strong impact on the recruitment of cognitive control processes and affective responses to errors during subsequent learning. They also confirm and extend prior studies showing a positive relationship between negative affect and ERN/Ne magnitude.

F106

MANIPULATION OF CONFLICT STRENGTH IN THE FLANKER TASK: DOES STIMULUS CONTRAST MATTER? Jessica Strozyk[1], Ines Jentzsch[1]; [1]University of St Andrews — According to one influential theory, people monitor for the occurrence of conflicts in information processing in order to evaluate the need for cognitive control. Conflict in this sense is defined as the simultaneous activation of incompatible response tendencies. One task that has been widely used to investigate this kind of conflict is the Eriksen flanker task. The current study uses an adaptation of this task, in which the contrast of target and flanker letters has been varied independently to enhance or decrease conflict, respectively. Effects of this manipulation on both behavioural and electrophysiological data are explored. A main effect of target contrast on reaction times confirms that the manipulation was effective. Neither the contrast manipulation of the target nor of the flankers had differential effects on the flanker effect, which contradicts the predictions of the conflict-monitoring theory. The anterior N2, a component of the event-related potential that has been related to conflict processing on correct trials, showed an increase in amplitude on incongruent trials as compared to congruent trials, thereby confirming previous findings. Additionally, conflict-related and attentional effects related to flanker and target contrast can be observed in the N2 component.

F107

PERFORMANCE MONITORING AND THE EVALUATION OF ERROR SOURCE: ERROR-RELATED BRAIN ACTIVITY AND BEHAVIORAL ADJUSTMENTS FOLLOWING DIFFERENT ERROR TYPES Marco Steinhauser[1], Martin E. Maier[1], Andrea Kiesel[2]; [1]University of Konstanz, [2]University of Würzburg — The continuous monitoring of action outcomes is crucial for the optimization of performance. This is achieved by a performance monitoring system, which detects errors and adjusts behavior in order to reduce the probability of further errors. Evidence for such a system has been provided by studies showing a relation between behavioral adjustments and the error-related negativity (Ne/ERN), a negative deflection in the event-related potential following error responses, which is assumed to reflect performance monitoring in the medial frontal cortex. The present study examined whether this system evaluates the source of an error to adjust behavior appropriately. To this end, we compared behavioral adjustments following different error types in a flanker paradigm and examined whether these adjustments are related to the Ne/ERN. Experiment 1 showed that only errors resulting from a failure of attention imply adjustments of attentional selectivity whereas other errors imply only adjustments of response speed. Experiment 2 showed that, in contrast to internally caused errors, externally caused errors are followed by a transient reduction of effort. In both experiments, the strength of behavioral adjustments was related to the amplitude of the preceding Ne/ERN. This suggests that the performance monitoring system represented by the Ne/ERN initiates behavioral adjustments based on the evaluation of error source.

F108

THE LEFT INFERIOR FRONTAL GYRUS, INTERFERENCE RESOLUTION, AND SEMANTIC SHORT-TERM MEMORY Corinne Allen[1], Loan Vuong[1], Randi Martin[1]; [1]Rice University — Previous single case patient studies have shown an association between left inferior frontal gyrus (LIFG) damage and deficit in resolving interference in working memory. A single case LIFG patient ML showed an additional association between interference resolution deficit and semantic short-term memory (STM) deficit. This study tested a new LIFG patient EV, a control non-LIFG patient MB, and presented new data from LIFG patient ML to further elucidate the relationships. To examine interference resolution ability, the Stroop task, the picture-word interference task, and a modified version of the recent-negatives task were tested on the patients and age-matched controls. To examine STM abilities, several semantic and phonological STM tasks were administered and composite phonological and semantic STM scores were computed for each patient (in a group of 11 patients). EV and ML consistently showed exaggerated interference effects, compared to normal controls, across the three interference resolution tasks while MB did not. All three patients showed reduced STM ability compared to normals. Patient EV showed a pattern of semantic STM deficit, while patient ML, who was previously classified as a semantic STM patient, showed both phonological and semantic STM impairments. In contrast, MB showed a larger impairment in phonological STM. These results provide further evidence for the critical role of the LIFG in interference resolution in working memory. Additionally, they provide additional evidence for a relationship between the ability to resolve interference and ability to maintain semantic information in STM, as the two patients with larger semantic STM deficits showed exaggerated interference.

F109

THE ROLE OF MEDIAL-FRONTAL CORTEX IN LANGUAGE ACQUISITION Paul W. Gosset[1], Olav E. Krigolson[1], Todd C. Handy[1]; [1]The University of British Columbia — Recent experimental evidence suggests that a reinforcement learning system within medial-frontal cortex plays a key role in several types of learning. For instance, one recent study demonstrated that the medial-frontal system plays a role in the acquisition of perceptual expertise (Krigolson, Pierce, Tanaka, & Holroyd, 2009). In the present study, we sought to assess whether or not the medial-frontal system plays a role in language acquisition. The error-related negativity (ERN) is a component of the event-related brain potential (ERP) thought to reflect error evaluation by the medial-frontal system. To examine the role of medial-frontal cortex in language acquisition, we recorded ERP data while participants learned symbol word pairings for a novel language via a trial and error shaping process. Our behavioural results demonstrated that participants learned the correct meanings of the symbols, as indicated by improvements in accuracy and decreases in response time. Further, the number of symbols participants knew significantly increased over the course of the experiment. Analysis of feedback averaged waveforms showed differences between correct and error trials consistent with previous accounts of the ERN. Interestingly, analysis of the stimulus averaged waveforms revealed activations over posterior parietal and temporal regions of cortex that increased with learning. In sum, our results suggest that a reinforcement learning system in medial-frontal cortex plays a role in language acquisition.

F110

WHY THE WHITE BEAR IS STILL THERE: ELECTROPHYSIOLOGICAL EVIDENCE FOR IRONIC SEMANTIC ACTIVATION DURING THOUGHT SUPPRESSION Ryan J. Giuliano[1], Nicole Y. Y. Wicha[1,2]; [1]University of Texas, San Antonio, [2]University of Texas Health Science Center, San Antonio — Research on the paradoxical effects of thought suppression has lead to the viewpoint that increased unwanted thoughts are due to an ironic monitoring process, which increases activation of the very thoughts one is trying to rid from consciousness. However, there is no direct evidence that thoughts become more accessible during suppression. Event-related potentials were recorded from word onset during a lexical decision task that included a target, unrelated and non- words. Participants (N = 20) suppressed then expressed, or vice versa, thoughts of each target word across different blocks while pressing a button for non-words. Results revealed larger N1 amplitude for expressed than suppressed targets, suggesting that expression elicited greater perceptual processing than suppression. In contrast, we observed smaller N400 amplitude for target words when suppressed than expressed, suggesting that semantic activation was facilitated by thought suppression despite the decreased perceptual processing relative to expression. Only target word ERPs, and not unrelated or non-words, were modulated by the mental control conditions. Replicating prior findings, self-reported occurrences of target thoughts during a free association period prior to each lexical decision block were more frequent during expression than suppression revealing a dissociation between brain and behavioral responses. Overall, results provide electrophysiological evidence for ironic semantic activation during thought suppression, and demonstrate one way to measure the elusive unconscious mind. These findings shed light on a cognitive mechanism that may become dysfunctional in clinical populations suffering from recurring intrusive thoughts, such as OCD, PTSD, and depression.

F111

PINNING DOWN RESPONSE INHIBITION IN THE BRAIN – CONJUNCTION ANALYSES OF THE STOP-SIGNAL TASK Carsten Boehler[1,2], Lawrence Appelbaum[1], Ruth Krebs[1,3], Jens-Max Hopf[2,3], Marty Woldorff[1,4]; [1]Center for Cognitive Neuroscience, Duke University, Durham, NC, [2]Leibniz-Institute for Neurobiology, Magdeburg, Germany, [3]Otto-von-Guericke-University, Magdeburg, Germany, [4]Duke University, Durham, NC — Successful behavior requires a finely-tuned coordination of initiating and inhibiting motor programs to react effectively to constantly changing environmental demands. A particularly useful paradigm for investigating inhibitory motor control is the Stop-signal task, where already-initiated responses to Go-stimuli are to be inhibited upon the rapid subsequent presentation of a Stop-stimulus (yielding successful and unsuccessful Stop-trials). Although this paradigm has been used extensively in functional neuroimaging, there is no consensus on which functional comparison is best suited to characterize response-inhibition-related brain activity. Here, we utilize conjunction analyses of successful and unsuccessful Stop-trials that were each contrasted against a reference condition. This conjunction approach identifies only processes shared by both Stop-trial types, thereby capitalizing on the presence of response-inhibition-related activity in both conditions. Using this approach on fMRI data from human subjects, we identify a network of brain structures common to both types of Stop-trials, including lateral-inferior-frontal and medial-frontal cortical areas and the caudate nucleus. Moreover, comparisons with a reference condition matched for visual stimulation identified additional activity in the right inferior parietal cortex that appeared to play an important role in enhancing the processing of the Stop-stimuli. Finally, differences in stopping efficacy (measured by the Stop-signal response time, SSRT) across subjects were associated with activity variations in the left anterior insula. Importantly, however, this region was also associated with general task accuracy (which furthermore correlated inversely with the SSRT), suggesting that it might actually reflect a more general mechanism of performance control that supports response inhibition in a relatively unspecific way.

F112

THE INFLUENCE OF MOTOR SYSTEM FAMILIARITY ON ERROR EVALUATION IN MEDIAL-FRONTAL CORTEX Andrew J. Cornax[1], Olav E. Krigolson[1], Todd C. Handy[1]; [1]University of British Columbia — In general, people gain motor familiarity and dominance with the limb with which they do most of their daily tasks and can experience difficulties when trying to work with less practiced limbs. For example, this can easily be seen when right-handed people attempt to write with their left hand. Here we sought to assess whether or not motor system familiarity influenced error evaluation within medial-frontal cortex. The error-related negativity (ERN) is a component of the event-related brain potential (ERP) associated with error evaluation within medial-frontal cortex. We hypothesized that ERN amplitude would be influenced by motor system familiarity, i.e., errors made by a less practiced movement effector would elicit a larger ERN. On each experimental trial of our task, participants heard an auditory tone and were asked to respond by pressing a mouse button when they thought one second had elapsed. Response modality changed several times during the task, with participants having to respond to the auditory tone using their right hand, left hand, right foot, and left foot in different experimental blocks. Analysis of the ERP waveforms elicited by the feedback stimuli revealed an ERN in all four experimental conditions. Additionally, we found that ERN amplitude was modulated by response modality – the ERN elicited by errors made by the right hand was smaller than the ERN elicited by errors made by the left hand and either of the feet. Importantly, these data suggest that motor system familiarity impacts error evaluation within medial frontal cortex.

F113

TRANSCRANIAL MAGNETIC STIMULATION: A PARADIGM FOR THE STUDY OF SELECTIVE RESPONSE INHIBITION. A. D. van Campen[1], W. P. M. van den Wildenberg[1], K. R. Ridderinkhof[1]; [1]University of Amsterdam, The Netherlands — Selective inhibitory control when selecting between two actions is an important aspect of goal-directed behavior. In this study, we applied transcranial magnetic stimulation (TMS) during action selection in a conflict situation. The goal of the experiment is to link behavioral indices of top-down suppression of involuntary response impulses with physiological markers and to track its time course. In the Simon task, participants respond to a relevant feature (circle color) while ignoring an irrelevant feature (circle location). This setup yields conflict trials in which participants should respond with their left hand according to the color of a circle, while the right stimulus position automatically activates a right-hand response. Single-pulse TMS is applied on the motor cortex at five different time intervals after signal onset to track the excitation and suppression of cortico-spinal motor activity related to the right hand. The timing of the TMS pulse is based on individual reaction time distribution parameters. Motor evoked potentials (MEPs) and silent periods (SPs) are derived from the electromyogram recorded from the thumb muscle. Results indicate a dynamic pattern of selective suppression of interfering response tendencies, resulting in smaller interference effects for slower responses. This pattern is accompanied by changes in duration of SP and differences in cortico-spinal excitability measured with MEP. TMS seems to be an appropriate tool to measure cortical inhibition during goal-directed action selection in conflict situations.

F114

ERROR MONITORING AND FEEDBACK-BASED LEARNING IN OBSESSIVE-COMPULSIVE DISORDER Tanja Endrass[1], Christian Kaufmann[1], Anja Riesel[1], Svenja Köhne[1], Rosa Grützmann[1], Norbert Kathmann[1]; [1]Humbolt-University Berlin, Germany — Event-related brain potential (ERP) and functional neuroimaging studies in patients with obsessive-compulsive disorder (OCD) revealed increased error-related negativity (ERN) amplitudes and hyperactivity in fronto-medial brain regions following incorrect responses. To date, inconsistent results exist with respect to processing of performance feedback which is associated with similar brain regions and comparable underlying processes. The ERN is assumed to reflect the activity of a monitoring system that triggers subsequent adjustment of cognitive control to prevent future errors or to learn from previous incorrect behavior. The aim of the current study was to elucidate the relationship between performance monitoring in OCD and behavioral alterations in terms of feedback-based learning. 14 OCD patients and 14 healthy controls performed a probabilistic learning task and a modified flanker task while ERPs were recorded. This enabled the investigation of response- and feedback-related ERPs in the same group of participants. Although both groups achieved comparable learning performance, OCD patients showed superior avoidance learning in the probabilistic learning task. Consistent with earlier findings, OCD patients had enhanced error-related negativities compared to healthy controls, but they had reduced feedback-related negativities in the learning task. These data indicate that OCD patients show altered error monitoring that is linked to their enhanced effort to avoid potential negative consequences of their actions as reflected by better avoidance learning.

Methods: Neuroimaging

F115

A FMRI STUDY OF COGNITIVE SKILL RELATED NEURONAL PLASTICITY Natasha Ludwig[1], Stephen Romero[1], Natalie Staples[1], Earl Zimmerman[2], Jordan Grafman[3]; [1]Union College, [2]Albany Medical College, [3]National Institute of Neurological Disorders and Stroke — In the present study, Functional Magnetic Resonance Imaging (fMRI) was utilized to investigate neuronal plasticity associated with learning a cognitive skill. Twenty participants were scanned over three days of training with an alphabet addition task (e.g., e+3=h True or False?). Behavioral results suggest that participant's performance became automated with practice due to a switch in cognitive strategy from mentally counting-up in the alphabet to retrieving the answer from memory. On the first day of training, participants' mental counting performance was associated with activation in the left inferior frontal gyrus, left cingulate gyrus and right parahippocampul gyrus. Left caudate nucleus activation can be associated with the task general strategy choice process. The imaging results also support the occurrence of dynamic activation changes across three days of practice. Linear increases in activation in the right insula, left medial frontal gyrus and left transverse gyrus can be associated with the formation of problem specific representations to support the switch to memory based performance. A linear activation increase that was not task specific was found in the superior frontal gyrus. One possible interpretation is in terms of the development of an experiment specific representation of the meta-knowledge associated with performance in this paradigm. A quadratic change in activation (increase and then decrease in activation) in the left cingulate gyrus was probably due to attentional changes during all 3 scanning sessions. These results suggest that neuroplastic based activation changes can be tracked with fMRI and further suggests the utility of using learning in fMRI studies.

F116

IN SEARCH OF A COMMON REPRESENTATIONAL SPACE FOR DECODING: COMPARING ANATOMICAL ALIGNMENT, FUNCTIONAL VOXEL MATCHING, AND HYPERALIGNMENT J. Swaroop Guntupalli[1], James V. Haxby[1]; [1]Dartmouth College, Hanover, NH — Many recent studies have shown that the information content of brain states can be decoded using multivariate pattern analysis of functional MRI (fMRI) measures. Since cross-subject registration of brain anatomy aligns only coarse structure, most studies build subject-specific decoding models because of individual variability at fine-scale in both anatomical structure and functional patterns. To address this issue, we have developed a new alignment method, hyperalignment, that aligns each subject's multi-voxel representational space to a common space. We derived our alignment parameters using fMRI data that we obtained from ventral temporal cortex while ten subjects watched a full-length action movie. We then used these parameters to transform fMRI data from another experiment, in which the same ten subjects were shown images of seven categories of objects and faces, into the same common high-dimensional space. A classifier trained on the hyperaligned data for nine subjects from the second experiment to classify these seven categories was able to predict the categories of left-out subject's hyperaligned data with a mean classification accuracy of 61.3%. This between-subject classification (BSC) performance was equivalent to mean within-subject classification (accuracy=60.3%) and was significantly higher than BSC after anatomical alignment (mean accuracy=47.8%). We further constrained alignment to functional voxel matching which derives an optimal one-to-one mapping of voxels between subjects (a permutation) which gave a mean BSC accuracy of 57%. These results demonstrate that hyperalignment provides a better functional alignment than does voxel matching and anatomical alignment, and efficiently captures between subject commonalities in response patterns.

Methods: Other

F117

REDUCED CORTICAL THICKNESS IN LEFT POSTERIOR TEMPOROPARIETAL REGIONS IN HIGH FUNCTIONING AUTISM SPECTRUM DISORDER Nathan Dankner[1], Alex Martin[1], Jay Giedd[2], Gregory Wallace[1]; [1]Laboratory of Brain and Cognition, [2]Child Psychiatry Branch, NIMH — Autism Spectrum Disorders (ASD) share core social communication deficits that may be reflected in anatomical differences in specific regions of the brain. Previous studies suggest that in ASD early cortical overgrowth is followed by prematurely arrested growth. Only a few studies have investigated cortical thickness (CT) in ASD, with inconsistent results, likely due to variable ages and/or small sample sizes. In one of the largest studies to date, we assessed differences in CT between high functioning adolescent males with ASD and typically developing (TD) males. T1-weighted MPRAGE 3T MRI scans were acquired from 40 high-functioning males with ASD and from 41 TD males matched group-wise on age (range 12-24 years), IQ (?85), and handedness. Vertex-based analysis using the FreeSurfer image analysis suite revealed significantly thinner (cluster-corrected ps<.05) cortex in the ASD group limited to posterior temporoparietal regions of the left hemisphere (i.e. postcentral/superior parietal gyri, supramarginal gyrus, superior temporal sulcus, inferior temporal gyrus, as well as a trending cluster in fusiform gyrus (p=.084)). Consistent with notions of early arrested growth, group differences were restricted to thinner cortex in ASD, which was regionally specific and may reflect social communication difficulties.

F118

NEURAL CONNECTIVITY IN MULTIPLE SCLEROSIS Victoria Leavitt[1], Glenn Wylie[1], Bharat Biswal[2], Helen Genova[1], John DeLuca[1], Nancy Chiaravalloti[1]; [1]Kessler Foundation Research Center, [2]University of Medicine and Dentistry of New Jersey — Functional neuroimaging research has sought to characterize unique patterns of activation in individuals with multiple sclerosis (MS) during various cognitive tasks. However, few investigations have explicitly endeavored to characterize functional and effective connectivity in the context of a cognitive task for this population. Using functional magnetic resonance imaging (fMRI), 16 individuals with MS were compared to 17 healthy controls (HCs) during performance of a processing speed task, a modified version of the Symbol Digit Modality Task. Functional connectivity analysis of the fMRI data–pair-wise correlations between regions shown to be active during task performance—showed decreased connectivity in left and right inferior frontal regions, dorsolateral prefrontal cortex (DLPFC), and parietal regions (P < 0.05, corrected) in the MS group relative to HCs. This decreased connectivity was seen both within and across hemispheres. Results using Granger causality analysis revealed strikingly different patterns of effective connectivity in individuals with MS compared to HCs. Notably, whereas HCs had cross-hemisphere connections in inferior frontal gyrus, DLPFC, and parietal regions, only one cross-hemisphere connection was observed in the MS group (left to right DLPFC). The implications of dramatically decreased connectivity in individuals with MS in the context of a cognitive task will be discussed.

F119

THE NEUROIMAGING INFORMATICS TOOLS AND RESOURCES CLEARINGHOUSE (NITRC) David Kennedy[1], Christian Haselgrove[1,2], Jeff Grethe[3], Nina Preuss[4], Robert Buccigrossi[4], Keith Wagner[4], Haig Evans-Kavaldjian[4]; [1]University of Massachusetts Medical School, [2]Neuromorphometrics, Inc., [3]UCSD, [4]TCG, Inc. — We report on the use of a neuroimaging informatics knowledge environment for functional and structural neuroimaging tools and resources entitled: Neuroimaging Informatics Tools and Resources Clearinghouse (NITRC). Initiated in October 2006 through the NIH Blueprint for Neuroscience Research, NITRC's mission is to foster a user-friendly knowledge environment for the functional and structural neuroimaging community. By continuing to identify existing software tools and resources valuable to this community, NITRC's goal is to support its researchers dedicated to enhancing, adopting, distributing, and contributing to the evolution of neuroimaging analysis tools and resources. Located on the web at www.nitrc.org, this site promotes software tools and resources, vocabularies, test data, and databases, thereby extending the impact of previously funded, neuroimaging informatics contributions to a broader community. NITRC gives researchers greater and more efficient access to the tools and resources they need, better categorizing and organizing existing tools and resources, facilitating interactions between researchers and developers, and promoting better use through enhanced documentation and tutorials—all while directing the most recent upgrades, forums, and updates. In Summary, NITRC facilitates access to an ever growing number of functional and structural neuroimaging tools and resources (220 to date). We encourage the community to continue providing design and content feedback. Averaging monthly 525,000 hits and 9,000 unique visitors, NITRC is now an established knowledge environment for the functional and structural neuroimaging community where tools and resources are presented in a coherent and synergistic environment for the advancement of functional and structural neuroimaging research.

F120

HOW RELIABLE ARE THE RESULTS FROM FMRI? Craig Bennett[1], Scott Guerin[2], Christa-Lynn Donovan[3], Elissa Aminoff[1], Danielle King[1], Amy Frithsen[1], Brian Lopez[1], Michael Miller[1]; [1]University of California, Santa Barbara, [2]Harvard University, [3]Stanford University — Functional magnetic resonance imaging is one of the most important methods for in vivo investigation of cognitive processes in the human brain. Within the last two decades an explosion of research has emerged using fMRI, revealing the underpinnings of everything from motor and sensory processes to the foundations of social cognition. While these results have opened our eyes to the potential of neuroimaging, important questions regarding the reliability of these results remain unanswered. In this poster we report on the test-retest reliability of fMRI data from three existing neuroimaging investigations. With this data we examine how the factors of task type (episodic recognition, two-back working memory, perceptual discrimination), experimental design (block design, event-related design), and test-retest interval (20 minutes, 24 hours, 6 months) influence reliability. We used intra-class correlation (ICC) to measure reliability across these factors. There were several findings from this investigation. First, reliability varies greatly depending on the task used. Perceptual discrimination had the highest reliability (mean ICC = 0.60), followed by working memory (mean ICC = 0.52), and then episodic recognition (mean ICC = 0.48). Second, block designs generally had greater reliability relative to event-related designs. Third, extended test-retest intervals reduced the reliability of the results. It appears to be the case that numerous factors influence the reliability of fMRI results. It also appears to be the case that fMRI studies may be less reliable than many scientists assume. [Supported by the Institute for Collaborative Biotechnologies through grant W911NF-09-D-0001 from the U.S. Army Research Office]

F121

EVIDENCE FOR NEURAL CONNECTIVITY ANOMALIES IN ADULT FEMALE FMR1 PREMUTATION CARRIERS WITHOUT EVIDENT DEGENERATIVE NEUROCOGNITIVE SYMPTOMS Siddharth Srivastava[1,4], Heather Shapiro[1,4], Yingratana McLennan[1,4], Lindsey Marcelino[1,4], Christine Godwin[1,4], Flora Tassone[2,4], Susan Rivera[1,3,4], Tony J. Simon[1,4]; [1]M.I.N.D Institute, [2]School of Medicine, [3]Center for Mind and Brain, [4]University of California, Davis, CA — Fragile X premutation carriers (fXPCs) are defined as having trinucleotide expansions between 55 - 200 CGG repeats in the in the 5′ untranslated region of the fragile X mental retardation 1 gene (FMR1). Typically female fXPCs below age 40 years old present with few or mild cognitive and behavioral non-debilitating impairments and increased frequency of autoimmune diseases including autoimmune thyroid diseases, fibromyalgia and multiple sclerosis. Relative to males, fewer females develop the degenerative tremor/ataxia disorder (FXTAS) in later life, though the prevalence of these cases is currently unknown. Using Diffusion Tensor Magnetic Resonance Imaging we derived anatomical connectivity metrics, sensitive to the tracto-linear water diffusion integrity in white matter, to explore regionally significant anomalies in the brains of young female fXPCs with mild or no neurocognitive symptoms. A group analysis comparing Fractional Anisotropy (FA) values in neurotypical participants and female fXPCs showed regionally significant clusters at the level of medial cerebellar peduncle (MCP, bilateral) and in the white matter in close proximity to the fornix, where FA values in the typicals were higher then the fXPC group. Correlation with CGG repeat length within the fXPC group revealed that the FA values in the left MCP cluster showed a significant negative linear correlation with CGG repeat length. The FA anomalies correspond anatomically with T2 hyperintensities in MCP of older patients with FXTAS, indicating that a discriminative, and possibly predictive, imaging phenotype exists at the mesoscopic level in the brains of young females fXPCs presenting without clear degenerative neurocognitive symptoms.

Neuroanatomy

F122

A NOVEL SETUP FOR INTEGRATIVE EEG AND FMRI IN BOTH HUMAN AND NON-HUMAN PRIMATES Ricardo Gil-da-Costa[1], Thomas Liu[2], Jeng-Ren Duann[2], Raynard Fung[1], Thomas Albright[1]; [1]Salk Institute for Biological Studies, [2]UCSD — A full understanding of the underlying neural substrates of behavior requires multiple levels of analyses, from the single neuron to brain areas and neuronal networks. A major gap in the linking of human and non-human primate (NHP) research has been the lack of adequate translation of findings resulting from different methods. In humans, non-invasive methods provide insight into large-scale patterns of neuronal activity but have limited temporal and/or spatial resolution. Conversely, the invasive methods used in NHPs provide fine-grained analysis of single neurons activity but little insight into the larger-scale patterns. It is paramount to adequately integrate the vast knowledge gained from animal electrophysiological studies on molecular and cellular mechanisms with current and future findings from human brain imaging studies on large-scale neuronal networks. We will present the development of a novel brain imaging setup for the simultaneous acquisition and integration of electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) data in humans and non-human primates (NHPs), which we believe will contribute to bridge this gap by: i) Developing an integrative approach for simultaneous acquisition, and subsequent analysis of EEG recordings and fMRI scans in humans; ii) Implementing a novel non-invasive whole-brain EEG system for awake NHPs; and iii) Establishing a common platform for simultaneous EEG and fMRI acquisition in both species. These developments allow for the application of the same methods in humans and NHPs, thus allowing these data sets to be directly compared, bridging not only species but also "Systems" and "Cellular" neuroscience research.

F123

IMAGING MARKERS RELIABLY DETECT AND DISSOCIATE ALZHEIMER'S DISEASE AND FRONTOTEMPORAL LOBAR DEGENERATION Matthias Schroeter[1,2], Jane Neumann[1]; [1]Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]University of Leipzig, Day Clinic of Cognitive Neurology, Leipzig, Germany — Recently, the incorporation of standardized imaging inclusion criteria into future diagnostic systems has been suggested. Alzheimer's disease (AD) and frontotemporal lobar degeneration (FTLD) are the most common dementia syndromes. Comprehensive meta-analyses are the best choice to validate the impact of imaging markers on diagnosis and differential diagnosis. Accordingly, we characterized the prototypical neural correlates of AD/FTLD in systematic and quantitative meta-analyses involving 1618 patients and 1448 controls by calculating anatomical likelihood estimates. For AD and its prodromal stage (mild cognitive impairment, MCI) we revealed alterations in a temporoparietal network related to episodic memory. AD additionally involved frontomedian-thalamic structures. Impairments in the (trans-)entorhinal area/hippocampus and the inferior parietal lobules predicted most reliably the progression from MCI to AD, whereas changes in the posterior cingulate cortex and precuneus were unspecific. For FTLD, we "triple dissociated" the prototypical neural substrates of its three subtypes (frontotemporal and semantic dementia, progressive non-fluent aphasia). Whereas the first subtype affected the frontomedian network of social cognition, the second was related to the inferior temporal poles and amygdalae discussed in the context of conceptual knowledge, semantic information processing, and social cognition. The last FTLD subtype involved the left frontotemporal network for phonological and syntactical processing. A conjunction analysis identified only one brain area, where atrophy coincided in AD and semantic dementia (amygdale/hippocampal head). Data suggest a specific neural dissociation of AD and the three FTLD subtypes. Results support the incorporation of standardized imaging inclusion criteria into future diagnostic systems, which will be crucial for early diagnosis and treatment.

Other

F124

RELATIONSHIP BETWEEN CORPUS CALLOSUM SIZE AND INTELLIGENCE IN A LARGE HEALTHY REPRESENTATIVE SAMPLE Hooman Ganjavi[1], Sherif Karama[2], John Lewis[2], Penny MacDonald[1], Alan Evans[2], Brain Development Cooperative Group[3]; [1]McGill University, Montreal, Quebec, [2]McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University, Montreal, Quebec, [3]National Institutes of Health, Bethesda, Maryland — The relationship between corpus callosum (CC) and cognitive ability in healthy individuals is unclear. Studies thus far have produced inconsistent results. We have attempted to address this issue by examining this relationship in a large healthy representative sample. We used structural MRI and IQ data collected in almost 500 children and adolescents aged six to 18 as a part of the NIH MRI Study of Normal Brain Development. Mid-sagittal CC area was calculated and subdivided using a semi-automated technique based on the Clarke technique. Cognitive ability was measured using the full-scale WASI-IQ which consists of performance intelligence (PIQ) and verbal intelligence (VIQ) subscores. Statistical analyses were performed using SPSS 16.0. A significant negative correlation was found between CC area and IQ after correcting for brain volume. When subjects were divided into children (age < 12) and adolescents (age ? 12), the relationship held for children, but not for adolescents. Dividing the subjects by gender revealed that the negative correlation was only found in males. The relationship was stronger in PIQ than VIQ. Our data suggests that the relationship between CC area and intelligence is a function of age and gender, and that CC area is more related to PIQ rather than VIQ. Our study adds support to the notion that there is a negative correlation between CC area and intelligence that depends on age and gender.

F125

A NEW PARADIGM TO STUDY ACOUSTIC SHORT-TERM MEMORY Synthia Guimond[1], François Vachon[2], Christine Lefebvre[1], Stephan Grimault[1], Pierre Jolicoeur[1]; [1]Université de Montréal, [2]Université Laval — We studied acoustic short-term memory (ASTM) using the event-related potential (ERP) technique. Other work in our lab has revealed an increased negativity at fronto-central electrodes during retention when we increased the number of tones varying in pitch (i.e. the load) in a sequence to be maintained in ASTM. In the present study, we created a new paradigm to avoid sequential presentations in order to be sure that this activity was caused by the retention of pitch and not by the retention of melodic contour of the sequences. In the new paradigm, we presented the to-be-remembered tones simultaneously, rather than sequentially. We found the same increase in fronto-central negativity when we increased the load that had been found in previous work with sequences of tones. This effect was absent in a control task involving the same stimulation but no requirement to remember the information. These results show that fronto-central negativity corresponds to the active maintenance of acoustic objects in ASTM rather than to the complexity or length of melodic contour, or the mere perception of multiple sound objects.

F126

NEURAL CORRELATES OF INTENSIVE MOBILITY TRAINING AND VIRTUAL ENVIRONMENT REHABILITATION Alexandria Reynolds[1], Julie Conder[1], David Blitzer[1], Brennan Baylis[1], Mackenzie Sunday[1], Peter Lauten[1], Debra Krotish[2], Stacy Fritz[1]; [1]University of South Carolina, [2]Palmetto Health Richland Hospital — Stroke is a leading cause of disability, causing a large decrement on the person's quality of life. Recent aggressive and intensive therapeutic approaches show promise for great reduction of impairments caused by brain damage. The purpose of this study is to investigate the neural effects of two novel mobility therapies, Intensive Mobility Training (IMT) and Virtual Environment Rehabilitation (VEHAB), and their effects on motor function. Functional Magnetic Resonance Imaging (fMRI) was used to detect therapy-induced neural changes in patients with hemiparesis. Subjects performed three motor tasks while undergoing fMRI scanning, and were scanned both prior to and after the rehabilitation therapy. Responding to visual cues, subjects were instructed to move their right or left limb and perform the following in succession: toe-point, flexion-extension, and hand-grip. The pre-therapy fMRI data were analyzed using the FEAT method in FSL and compared to the analyses of brain activity conducted after completing the two-week intensive therapies. In some patients, therapy increased the amount and extent of activation associated with the motor tasks within the motor cortex; in other cases, therapy appears to have recruited a large network outside of motor cortex as evidenced by widely distributed increases in activation. In a second part of the study, structural scans including T1, T2, and Diffusion-Weighted Images, were collected prior to therapy to be used as a predictor of the degree of motor improvement from therapy. Preliminary results suggest that both therapeutic approaches are most successful in patients where white matter is relatively spared.

F127

WHITE MATTER CHANGES IN FRONTOTEMPORAL DEMENTIA AS REVEALED BY DIFFUSION TENSOR IMAGING Kyle B. Womack[1], Jeremy F. Strain[2], John Hart[2], Ramon Diaz-Arrastia[1]; [1]University of Texas Southwestern Medical Center at Dallas, [2]University of Texas at Dallas — We hypothesize that differences in white matter integrity exist between subjects with Frontotemporal Dementia (FTD) and normal controls. Diffusion Tensor Imaging (DTI) is an MRI technique that is sensitive to changes in white matter integrity. We used DTI to look at group differences in fractional anisotropy (FA) between subjects with FTD and normal controls. DTI scans were obtained in 32 subjects, 16 FTD and 16 controls. Images were processed using the DTIfit and Tract Based Spatial Statistics (TBSS) tools from the FSL software package. We performed a voxel-wise comparison of the central core white matter skeleton using a threshold-free cluster analysis with correction for multiple comparisons (?=0.05). Reductions in FA were widespread. In the mid-saggital slice, the anterior half of the corpus callosum, a small area at the isthmus of the corpus collosum and the fornix showed reductions in FA. FA was reduced in the forceps minor and in much of the inferior prefrontal white matter. FA was also reduced in some parieto-occipital tracts, more notably on the right. To assess the contribution of reduced FA to neuropsychological measures, test scores for all subjects were correlated with the DTI measures. Moderate correlations between the mean FA of the anterior corpus callosum and Mini Mental Status Exam (r=0.527), Digit Symbol (r=0.459), Controlled Oral Word Association Test (r=0.553), Trailmaking Tests A (r=0.660) and B (r=0.566) ($p<0.001$ for all correlations). Conclusion: White matter integrity is impaired in FTD subjects as compared to controls and may contribute to impaired performance on neuropsychological tests.

F128

IMPROVING EFFICIENCY IN COGNITIVE NEUROSCIENCE RESEARCH WITH NEURODEBIAN Michael Hanke[1,2], Yaroslav Halchenko[1]; [1]Dartmouth College, [2]University of Magdeburg — Improving efficiency in cognitive neuroscience research with NeuroDebian Cognitive neuroscience research involves an increasingly complex set of software packages covering all aspects from stimulus delivery, data collection and analysis to the visualization of results. Maintaining a functional research environment is a tedious task that takes away resources from actual research. Individual labs often try to limit this manpower drain by restricting the variety of available tools and only reluctantly upgrading their main analysis tools to new releases. This approach has a negative impact on the overall research efficiency, since it forces scientists to use particular -- potentially outdated -- tools regardless of their personal preferences and, moreover, disconnects the lab from the latest methodological developments in the field. The NeuroDebian project (http://neuro.debian.net) addresses this problem by offering a growing list of software tools for cognitive neuroscience research (e.g. AFNI, Caret, FSL, PsychoPy, PyEPL, PyMVPA, Slicer) that are readily integrated into the Debian operating system with its over 25000 other software packages. The well-known stability of Debian provides a reliable foundation to carry out everyday research routines, while NeuroDebian tracks the latest developments of relevant software and makes them available in this stable and rich environment. This poster demonstrates the simplicity of maintaining a NeuroDebian-based research system and shows how any researcher can easily set up fairly complex computing environments and keep them up-to-date in just a few minutes. Moreover it also shows how software developers of neuroscience analysis tools benefit from the integration of their software into the Debian system.

Attention: Nonspatial

F129

THE EFFECT OF BRIEF MINDFULNESS MEDITATION TRAINING ON STROOP INTERFERENCE AND ADAPTATION EFFECTS: EVIDENCE FOR INCREASED ATTENTIONAL FOCUS Mark Faust[1], Fadel Zeidan[2]; [1]University of North Carolina at Charlotte, [2]Wake Forest University — Long-term meditation practice is associated with changes in neural structure and function and enhancement of cognitive functioning. There is increasing interest in the effects of brief training. The present study examined the effect of brief mindfulness meditation training on the ability to avoid interference from distracting task-irrelevant information during performance of the Stroop color naming task (i.e., interference). In Experiment1, we used lists of congruent and incongruent stimuli. In Experiment 2, we used manual responses and randomly mixed individual trials, and were interested in the extent to which participants exhibited cognitive control by reducing the size of the Stroop interference effect on trials immediately following an incongruent trial versus following a congruent trial (i.e., adaptation). In Experiment 1, the meditation group produced a smaller Stroop interference effect, in comparison to non-meditators, in error rates, but not naming times. In Experiment 2, we found that meditators reduced the size of the Stroop effect following an incongruent trial (adaptation), in error rates and not response latencies, at both short and long delays, whereas non-meditators only did so at the short delay. The results of Experiment 1 suggest that brief meditation training resulted in a reduction in lapses of attention. The results of Experiment 2 suggest that meditators were better able to employ cognitive control processes to modulate attentional settings on a trial by trial basis to handle potential lapses of attention on incongruent trials. Overall, the results are consistent with recent suggestions that brief meditation training can improve attentional focus.

Emotion & Social: Emotion-Cognition Interactions

G1

NEURAL BASIS OF EMOTIONAL MODULATION WHILE MULTITASKING: ERP ANALYSIS Sean Seaman[1], Li Hsieh[1], Lina Wu[1], Richard Young[2]; [1]Wayne State University, [2]School of Medicine, Wayne State University — We investigated the role of emotion in multitasking using a task designed to assess the effects of speech on visual event detection during simulated driving. EEG brain activations and behavioral responses to visual stimuli in a go/no go task were collected while concurrently answering spoken questions. Behavioral results confirmed that visual event detection reaction time (RT) is slightly slowed by concurrent speech compared to no speech. However, this effect was moderated by presenting speech stimuli in an angry voice -- RTs were faster for angry than neutral speech. ANOVAs on within-subject ERPs among 16 subjects indicated that P300 amplitudes from parietal electrodes to target visual stimuli were elevated when a concurrent speech task was added to driving; crucially, though, this elevation was reduced for P300s observed during angry compared to neutral speech. Conversely, angry speech elicited larger P300 peak amplitudes than neutral speech from the right anterior frontal electrodes. Behavioral RTs were inversely correlated with P300 amplitude in the right anterior frontal region, indicating that neural activity here is associated with both angry speech stimuli and improved multitasking performance. These ERP results support our previous fMRI and MEG findings that the distraction effects of a secondary speech task on a primary visual task RT during simulated driving are correlated with increased cognitive load and attentional distribution. The novel contribution of this ERP study is that adding an angry emotional valence to the speech attenuates this distraction effect and improves multitasking performance, likely via increases in right anterior frontal activity.

G2

AN ERP INVESTIGATION OF THE THREAT SUPERIORITY EFFECT FOR EVOLUTIONARY RELEVANT AND IRRELEVANT STIMULI Isabelle Blanchette[1], Christopher Brown[2], Wael El-Deredy[2]; [1]Universite du Quebec a Trois-Rivieres, [2]University of Manchester — The threat superiority effect describes the fact that threatening stimuli attract attention particularly efficiently. In ERP studies, one type of evidence for this is a modulation of the P1 peak of the visual-evoked potential by threatening items. While theories have suggested that evolutionarily relevant threats should be preferentially processes, differential neural processing of evolutionary relevant and irrelevant threats has not yet been examined empirically. In this study we examined the effects of evolutionarily relevant (e.g. spiders and snakes) and irrelevant (e.g. knifes and syringes) threatening cues. We used a dot-probe task where non-predictive threatening and neutral cues were presented side by side, followed by neutral targets in one of the two locations. We recorded EEG from 61 scalp locations and examined ERPs to the target. The amplitude of the target P1 was increased in contralateral electrodes when it followed in the same location as a threatening cue, showing a threat superiority effect. This effect did not interact with evolutionary relevance. Both evolutionary relevant and evolutionary irrelevant threats led to increased P1 amplitude, although the effect was somewhat stronger for modern threats. We conclude that the threat superiority effect is robust and largely independent of the type of threatening stimulus.

G3

THE INFLUENCE OF HAPPY AND ANXIOUS MOODS ON THE SCOPE OF SELECTIVE VISUAL ATTENTION Ezra Wegbreit[1], Steven Franconeri[1], Mark Beeman[1]; [1]Northwestern University — Recent research has suggested that people in a positive mood show reduced attentional selectivity and broadened attentional filters. When participants listened to happy or sad mood-inducing music while performing a center-focus flanker task (i.e. report the center letter and ignore flanking distractors), they showed greater interference from incongruent flankers in a happy mood than in a sad mood (Rowe, Hirsh, & Anderson, 2007). This mood effect occurred even as flanker eccentricity increased, suggesting that the participants' broadened attentional scope impaired selective attention to the target. Experiment 1 of the current study extends these findings by manipulating mood with film clips played before (not during) the attention task, and by inducing an anxious mood rather than a sad mood. Sixty-six undergraduate participants completed a flanker task in positive and anxious moods (and participants' mood ratings indicated that the induced moods were sustained through the flanker task that followed the mood clips). Participants showed a greater flanker interference effect in the positive mood condition than in the anxious mood condition, but the effect was only reliable when the flankers were near the target (i.e. one letter width away, but not two letter widths away). Experiment 2, underway, investigates the role of positive and anxious moods on the spread of attention in a visual search task. We predict that participants will be better able to detect targets appearing farther from fixation when in a positive mood and will be better able to detect targets nearer to fixation when in an anxious mood.

G4

NEURAL CORRELATES OF EMOTIONS REGULATION IN THE HUMAN BRAIN Moran Cerf[1,2], Ralph Adolphs[1], Itzhak Fried[2,3]; [1]Computation and Neural Systems, California Institute of Technology, [2]University of California, Los Angeles, [3]Functional Neurosurgery Unit, Tel-Aviv Medical Center and Sackler Faculty of Medicine, Tel-Aviv University — Studies in emotions regulation show that subjects are able to alter their perception of a scene using cognitive strategies. Several studies with functional imaging suggest that areas such as the amygdala and the prefrontal cortex are involved in the task of regulating emotions in humans. We tested the ability of patients implanted with micro wires prior to resective surgery to control their emotions while viewing images that carry emotions with low and high valence and arousal. Subjects were viewing images in two conditions – either when they were instructed to emphasize with theh images, and when they were instructed to regulate their emotions and remain neutral when viewing the images. We recorded single units activity from the amygdala, hippocampus, entorhinal cortex, parahippocampal cortex and more. Neurons show responses from various types:

subsets of the neurons correlate with the successful regulation of emotions, while others respond to objective emotions reflected in the images, or to the subjective rating of those emotions by subjects. We categorize neurons by their response types (inhibition, excitation), latencies, and the duration of activity during the task. We identify neurons that show early response that is invariant to the emotions regulation (i.e. the neuron fires for various emotions either when the subject is emphasizing or passively viewing the image), and then show a later response only when the subject is reporting strong feelings towards the images. These results suggest a neural specificity in emotions regulation, and show evidence for interaction across brain areas during emotions regulation.

G5

THE AKAP5 GENE ENCODES A GENETIC MODIFIER OF AGGRESSION AND ANGER CONTROL Björn Schott[1,2,3], Sylvia Richter[1,2], Xenia Gorny[1], Ulrike Krämer[2], Grazyna Debska-Vielhaber[1,2], Antoni Rodríguez-Fornells[4], Carsten Reissner[5], Hans-Gert Bernstein[2], Hans-Jochen Heinze[1,2], Thomas Münte[2], Eckart Gundelfinger[1], Constanze Seidenbecher[1]; [1]Leibniz Institute for Neurobiology, Magdeburg, Germany, [2]University of Magdeburg, Germany, [3]Charite University Hospital, Berlin, Germany, [4]University of Barcelona, Spain, [5]University of Münster, Germany — Human aggressive behavior is modulated by negative emotions, particularly anger. Interindividual variability of aggression and anger is high and results, to considerable extent, from genetic contributions. The A-kinase-anchoring protein AKAP5 is involved in intracellular signaling related to monoaminergic neurotransmission, which has previously been linked to anger and aggression. Here we report an association of human aggression and anger with a genetic polymorphism (Pro100Leu) in the gene encoding A-kinase-anchoring protein 5 (AKAP5). Among 527 young, healthy individuals, carriers of the less common Leu allele (15.6% allele frequency) scored significantly lower in the physical aggression domain of the Buss-Perry Aggression Questionnaire (BPAQ) and higher in the anger control dimension of the State-Trait Anger Expression Inventory (STAXI). Functional MRI revealed an influence of AKAP5 Pro100Leu on the control of emotional interference. In a modified version of the Eriksen flanker task with task-irrelevant angry faces in the background, Leu carriers showed increased medial frontal cortex (mFC) activation during emotional interference, which in turn predicted shorter reaction times and might be related to the neural mechanisms underlying anger control. Immunohistochemistry revealed AKAP5 expression in the human mFC. Taken together, our results suggest that AKAP5 Pro100Leu contributes to genetic variability of aggression and anger as well as their cognitive control.

G6

COGNITIVE BEHAVIORAL THERAPY IS EFFECTIVE FOR REGULATING CONDITIONED FEAR Ashley A. Shurick[1], Lasana T. Harris[1], Claire J. Hoogendoorn[1], Amy K. Roy[2,3], Elizabeth A. Phelps[1]; [1]New York University, [2]New York University, Child Study Center, [3]Phyllis Green and Randolph Co-wen Institute for Pediatric Neuroscience — Cognitive behavioral therapy (CBT) has been shown to be an effective treatment of anxiety disorders, including social phobia (Juster & Heimberg, 1995) and generalized anxiety disorder (Gould et al., 2004). Previous work has demonstrated that employing cognitive reappraisal can lead to successful regulation of emotional responses (e.g., Ochsner et al., 2002). Although cognitive reappraisal is a component of CBT, these studies do not directly assess whether cognitive restructuring techniques used in CBT can regulate emotional responses in a laboratory paradigm. Our aim in this study is to utilize such techniques to attenuate conditioned fear responses. Using a Pavlovian conditioning paradigm, we paired images of either snakes or spiders with a mild shock to the wrist while collecting Galvanic skin response (GSR). After conditioning, the experimental group received CBT intervention aimed at decreasing their emotional response to the shock and the conditioned stimuli. The control group discussed their thoughts and emotions about the experiment, but did not receive any instruction about cognitive restructuring. All participants returned 24 hours later for a subsequent conditioning session. Results demonstrate a significant difference in GSR between the CBT and control group during the second session. Within the CBT group, conditioned fear decreased on day two relative to day one. These results provide physiological evidence for the effectiveness of CBT in diminishing fear. We also present data examining the neural correlates of emotion regulation with CBT.

G7

SITUATING EMOTION EXPERIENCE Christine Wilson-Mendenhall[1], Lisa Feldman Barrett[2,3], Lawrence W. Barsalou[1]; [1]Emory University, [2]Boston College, [3]Harvard Medical School — Much emotion research has focused on identifying biological patterns in the brain and body that characterize affective experiences classified as basic emotions (e.g., fear, anger). An alternative approach is to examine elements of emotion experience, such as situational context, that produce the dynamic realization of an emotional state. For example, fear may occur in situations varying from a physical danger to one's body to a social threat to one's ego or reputation, both of which require distinct, situated responses. In this fMRI study, participants imagined a variety of situations in which they were either in physical danger or being socially evaluated. Greater activation for physical danger situations was observed in a network of sensory-motor and affective regions, which included the insula, lateral orbitofrontal cortex, and middle cingulate. In contrast, social evaluation situations activated a network of mental state (many regions in the 'default' network) and distinct affective regions, which included ventral medial prefrontal cortex, medial orbitofrontal cortex, and the insula. Furthermore, participants' prior ratings of familiarity and their experience of 'being there' immersed in each imagined situation were correlated with activity in these networks. Whereas regions associated with visuospatial guidance of action showed increased activation with greater familiarity and immersion ratings for physical danger experiences, midline areas implicated in the default network showed a similar profile for social evaluation experiences. Taken together, these results suggest that situational context is critical to understanding how emotion experience is grounded in the brain.

G8

AGE-RELATED NEURAL DIFFERENCES IN EMOTION PROCESSING ARE MODULATED BY ELABORATION Maureen Ritchey[1], Brandy Bessette-Symons[1,2], Roberto Cabeza[1]; [1]Duke University, [2]Ithaca College — Emotion processing is generally conserved in older adults (OAs), but may be associated with age-related neural differences: OAs exhibit increased frontal and decreased posterior activations relative to young adults (YAs) during emotion processing. Differences also emerge with respect to emotional valence: OAs experience increased positive and decreased negative affect, and remember proportionately more positive stimuli than YAs. This pattern has been interpreted in terms of positivity bias as well as negativity reduction. Critically, age-related valence differences are thought to depend on OAs' capacity for controlled or elaborative processing, mediated by the frontal lobes. In the present study, we address the relationship between valence and elaborative processing by scanning YAs and OAs while they viewed negative, neutral, and positive pictures during either a deep, elaborative task or a shallow, perceptual task. Subsequent memory was tested after 1-2 days. Behavioral findings indicate that YAs and OAs had comparable arousal ratings and hit rates, showing memory advantages for deeply-encoded and/or emotional stimuli. Functional MRI results replicate increased frontal and decreased posterior activations during emotion processing in OAs. Furthermore, this study provides novel evidence for age differences in valence processing as a function of task: relative to YAs, OAs show enhanced activity in left inferior frontal gyrus, medial prefrontal cortex, and amygdala in response to positive versus negative stimuli, but only during deep processing. This finding suggests that frontal regions associated with elaborative processing are disproportionately engaged for positive material in aging. The relationship between these findings and subsequent memory will also be discussed.

G9

ACQUISITION OF SITUATED EMOTION CONCEPTS Lauren McDonough[1], Christine Wilson-Mendenhall[1], Lisa Feldman Barrett[2], Jessica Lake[3], W. K. Simmons[4], Lawrence Barsalou[1]; [1]Emory University, [2]Boston College, [3]Duke University, [4]The Laureate Institute for Brain Research — Much emotion research focuses on how simple stimuli produce automatic, bottom-up activation of simple response circuits, often believed to reflect discrete basic emotions with evolutionary significance. Human affect, however, is embedded in complex situations, characterized by dynamically constructed conceptualizations from which emotional experiences emerge. Thus we hypothesized that when a specific type of emotional situation is experienced repeatedly, an entrenched representation of the situation develops in memory comprised of a situated conceptualization and core affect. To test this hypothesis, two groups of participants repeatedly experienced fear either in physical situations (e.g., about to be hit by a car) or in social situations (e.g., about to be fired), but not both. The two groups also repeatedly experienced three other concepts (anger, plan, observe) either in physical or social situations. After extended training in one type of situation across two days, participants were scanned using fMRI while again processing the four concepts in the same type of situation (physical or social) experienced in training. On each trial, participants heard a concept word, listened to the description of a situation, and then rated how typical it is to experience the concept in the situation. Use of a catch trial methodology in a randomized event-related design allowed deconvolving BOLD activations for the emotion words from the subsequent situations. As predicted, the same emotion word activated different neural circuits in physical vs. social situations (between groups), consistent with the prediction that frequently experiencing a type of emotional situation establishes a situated emotion representation in memory.

G10

ANXIETY HIGHLIGHTS THE NEGATIVE: ELECTROPHYSIOLOGICAL EVIDENCE THAT PERSONALITY MODULATES AFFECTIVE PROCESSING Johanna Simpson[1], Stephen M. Lawrie[2], Jeremy Hall[2], David I. Donaldson[1]; [1]University of Stirling, [2]University of Edinburgh — Affective processing is known to influence cognitive processes like memory and attention; here we demonstrate that anxiety modulates this relationship. Electrophysiological research has shown that late-positive potentials (LPPs, centro-parietal positivities onsetting 400ms post-stimulus, reflecting sustained attention to stimuli) are increased in response to pictures of emotional compared to neutral content. Negative stimuli are consistently found to elicit larger LPPs than neutral stimuli; however evidence for a similar effect of stimuli with positive stimuli is mixed. One possible explanation for these variable findings is that they reflect different levels of anxiety across samples. For example, studies using behavioral methods suggest anxiety can modulate the allocation of attention to emotional stimuli. Here we investigate this possibility using neuroimaging methods. While EEG was recorded, 24 healthy participants viewed negative, neutral and positive images from the International Affective Picture System. The sample was split into non-anxious and mildly anxious participants, according to Beck's Anxiety Inventory scores. Both groups exhibited larger LPPs to negative and positive stimuli than neutral ones. Additionally, however, mildly anxious participants showed significantly larger LPPs in response to negative than to positive stimuli. These results suggest that previous evidence for significant affective processing effects for negative but not positive stimuli reflect the influence of anxiety as a modulator. We conclude that even small differences in trait anxiety, well below the threshold for clinical diagnosis, will produce differences in the neural correlates of affective processing. By implication, studies of emotional processing must always assess and report trait anxiety as a possible confound.

G11

IS PREDICTION ERROR SIGNAL EXPRESSED ON THE SCALP? Deborah Talmi[12], Lluis Fuentemilla[2], Emrah Duzel[2], Ray Dolan[2]; [1]University of Manchester, [2]UCL — Optimal decision-making must be guided by the evaluation of how previous decisions panned out. Prediction errors (PEs) are theoretical learning signals which integrate two features of the response to an outcome: the probability of its occurrence and its value. According to an axiomatic model (Caplin and Dean, 2008) neurobiological signals expressing PEs will always be stronger for positive than negative events, weaker for likely than unlikely events, and equivalent for fully-anticipated events. We employed these axioms to determine whether magnetoencephalography/ electroencephalography (M/EEG) recorded scalp signals express PEs. We acquired simultaneous M/EEG data while 17 adults performed a gambling task. Participants selected one of two gambles where value (win/loss) and probability (0-.25-.50-.75-1) were manipulated in each trial. Gamble outcomes were revealed for each trial. Analysing MEG data with SPM8 demonstrated that wins and losses were differentiated as early as 200ms after outcome revelation. The MEG signal that differentiated wins and losses was later modulated by loss but not win probability, resembling the feedback-related negativity observed in the EEG data at the same time but counter to the second axiom. MEG signal varied parametrically with probability in the win and loss domains, but with the same sign in both domains, counter to the pattern predicted by combination of the first two axioms. By using the axiomatic approach we determine that no scalp-time signal fulfilled all criteria for PE. We discuss the theoretical implications this finding has for interpretation of scalp signals as teaching signals, secondary to a primary striatal PE signal.

G12

QUICK TO PLEASE: ACCUMBENS RESPONSE TO ULTRASHORT PRESENTATIONS OF HAPPY FACES Bhismadev Chakrabarti[1,2], Caroline Robertson[1,3], Edward Bullmore[1], Simon Baron-Cohen[1]; [1]University of Cambridge, [2]University of Reading, [3]NIMH, National Institutes of Health — Happy faces presented below the threshold of conscious awareness causes valence-specific changes in choice behavior, a phenomenon known as "unconscious liking" (Berridge et al., 2003). Although the neural underpinnings of this phenomenon remain unclear, animal models implicate the nucleus accumbens (NAc). In a 3T fMRI experiment, we sought to test this hypothesis by measuring NAc response to unconsciously presented happy faces. 25 participants (13 female) performed a block-design gender-discrimination task on static photographs of neutral faces. Each face was preceded by either a conscious (13.3ms) or unconscious (133.3ms) prime of one of five expressions (happy, sad, angry, disgust, neutral). The data was preprocessed using SPM2, and the statistical analysis done using SPM8 (http://www.fil.ion.ucl.ac.uk/spm). A 50% probability mask of the NAc was created to estimate regional response to happy faces. This found significantly greater bilateral activity in the NAc for short compared to long prime durations ($p=<.03$), not observed for other emotions. A main effect of emotion compared to neutral expressions was observed for both long and short primes, suggesting emotion-specific activity at both levels of awareness. Additionally, the findings of Phillips et al. (2004) were replicated, demonstrating differential brain activity for disgust in the long vs. short prime condition. Our results support Berridge's hypothesis that the NAc plays a crucial role in the 'unconscious' perception of social rewards such as happy faces. This initial NAc response is inhibited at longer prime durations. This parallels earlier results in fear perception, where the amygdala responds to unconscious presentation of fearful stimuli.

G13

NEURAL CORRELATES OF THE ILLUSION OF CONTROL Sarah Getz[1], Wouter Kool[1], Matthew Botvinick[1,2]; [1]Princeton University, [2]Princeton Neuroscience Institute — When skill factors are introduced into chance situations, people often confuse luck for skill. This phenomenon is called the illusion of control (IOC; Langer, 1975). In the present investigation, we attempt to identify neural correlates of the illusion of control. We have behaviorally replicated Ellen Langer's IOC finding in an fMRI compatible paradigm in which participants showed greater self reported confidence in their performance in chance "lotteries" in a choice condition than in forced a choice condition. Specifically, in the choice condition, participants have the opportunity to choose between three "lotteries", and in the no choice condition, participants choices are vetoed by the computer. Currently, we are conducting an fMRI experiment in which we are comparing participants' reward prediction errors (RPEs) under the choice and no choice conditions. RPEs respond to the unexpected delivery or omission of reward, and have BOLD correlates in the ventral striatum. We are examining RPEs to wins versus losses, payoff probability, and critically choice versus forced choice trials. Specifically, we predict: 1) predict positive RPE to wins and negative to losses; 2) larger RPEs when payoff probabilities are smaller; and 3) larger RPEs to wins on forced choice trials than on choice trials, because reward expectancy is higher in choice trials.

G14

EMOTIONAL STIMULI INSIDE AND OUTSIDE THE CENTER OF ATTENTION Limor Lichtenstein-Vidne[1], Avishai Henik[1], Safadi Ziad[2]; [1]Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev, Israel, [2]College of Medicine, Howard University, Washington, DC — Goal directed behavior requires selective attention, namely, the ability to focus on task-relevant information and to ignore irrelevant data. This work examines whether the processing of peripheral emotional stimuli is contingent upon their relevance to the task at hand. All three experiments in the current study employed a Stroop-flanker task that combined a spatial factor and an emotional one. In the first and second experiments, participants were asked to determine whether a central target, either emotional or neutral, was located above or below a fixation point. In the third experiment participants were asked to decide whether the emotional target was either positive or negative. Across all experiments participants were asked to ignore the simultaneous presentation of peripheral emotional distracting stimuli. Results showed that task-relevance was a significant factor in processing peripheral stimuli. However, other factors may be involved while processing emotional stimuli, such as task difficulty and available cognitive resources.

G15

DIFFERENT PATTERN OF CEREBRAL ACTIVATION BETWEEN MEN AND WOMEN WITH SCHIZOPHRENIA DURING RECOGNITION OF POSITIVELY VALENCED IMAGES Nadia Lakis[1,2], José Jiménez[1,2], Adham Mancini-Marië[1,2], Annie Dubé[1,3], Marc Lavoie[1,2], Lahcen Bentaleb[1], Adrianna Mendrek[1,2]; [1]Centre de Recherche Fernand-Seguin, Louis-H Lafontaine Hospital, Montreal, Quebec, Canada, [2]University of Montreal, [3]Concordia University, Montreal, Quebec, Canada — Studies have shown that women outperform men and have different patterns of cerebral activation during emotional memory. It has also been demonstrated that patients with schizophrenia have impairments in both emotional processing and episodic memory. The goal of the study was to investigate both performance and brain function in schizophrenia men and women during an emotional memory task. Men (19-patient [SZ-M];19-controls [HM]) and women (18-patients [SZ-M];18-controls[HW]) were scanned using fMRI. Subjects viewed neutral and positively charged images selected from the international affective picture system (RUN 1). After a 15-minute interval of an unrelated cognitive task, participants underwent the emotional memory task (RUN 2) where 50% of the images were new and the other 50% were old images from RUN 1. The participants' task was to determine which of the stimuli were old and which were new. SZ-M performed worse (mean % correct=80.13, SD=12.86) than HM (mean=93.55, SD=6.68; p<0.001) and SZ-W performed worse (mean=76.61, SD=14.56) than HW (mean=92.8, SD=5.92; p<0.001). The fMRI results revealed greater activations in HM than in SZ-M in the right(R)-middle frontal and R-inferior frontal gyri, and greater activation in SZ-M than in HM in the bilateral(B)-postcentral, B-parahippocampal and R-superior temporal cortex. HW, on the other hand, activated the left(L)-calcarine and R-middle frontal cortex to a greater degree than SZ-W. Thus, differential patterns emerged between men and women in both groups; SZ-M demonstrated increased activity relative to HM whereas the opposite pattern was observed in women. These results are intriguing considering the lack of sex differences in performance.

G16

UNCONSCIOUS GOAL PRIMING CAN ALTER THE EFFECT OF ATTENTION AND EMOTION DURING FACE PROCESSING Swann Pichon[1], Patrik Vuilleumier[1]; [1]University of Geneva — Previous neuroscience research on unconscious processing has focused on how brain responses to emotional stimuli are modulated by top-down processes, such as voluntary endogenous attention. These effects do not provide a full account for understanding how internal states can influence unconscious processing in real life conditions. Abundant work in social psychology has demonstrated that unconscious goals can be primed by contextual manipulations, without subjects being aware of it, and later produce strong biases on information processing or behavior. Here we examined how current context, manipulated by means of an emotionally-laden semantic task, can subsequently alter brain responses during an unrelated visual task. We used fMRI in 20 subjects to compare responses to attended/unattended and fearful/neutral facial expressions as a function of the valence (negative or neutral) of semantic representations activated by a previous word completion task. Subjects were not aware of the priming manipulation. Replicating previous findings, our preliminary results show that fusiform responses to faces were modulated by attention, whereas amygdala responses to fearful faces were generally independent of attention. Most critically, we observed an interaction between context and attention in the right fusiform gyrus. Whereas attended (vs. unattended) faces produced increased fusiform responses after exposure to a neutral semantic context, this attentional modulation was strongly reduced after priming by negative semantics. Amygdala responses to neutral faces were also relatively enhanced after negative priming. These results suggest that both emotional and attentional processes may be significantly impacted by covert contextual manipulations, presumably reflecting unconscious changes in long-lasting affective states.

G17

INFLUENCE OF STRESS ON RECOGNITION MEMORY OF EMOTIONAL FACES ACROSS TIME OF DAY Bhaktee Dongaonkar[1], Lynn Nadel[1]; [1]University of Arizona, Tucson — A number of studies using emotional stimuli have shown that stress induced before encoding enhances memory recall while stress induced before retrieval impairs memory recall. Most of these stimuli were emotional pictures, slides, or videos. Such complex stimuli have information integrated from scenes, stories or narrations. In addition, studies that tested memory across different times of day have shown variable effects of memory for emotional material. We report here a study of how stress affects the recognition of the simplest form of emotional expression – facial expression. On the first visit, subjects were instructed to observe 120 emotional (40 sad, 40 happy, and 40 neutral) faces carefully. Half (60) of the faces from the first visit were replaced with new faces on the second visit, consistent across gender and expression. Twenty four hours later subjects were instructed to recognize the faces they had seen on their first visit as old or new. Subjects were stressed using the Trier Social Stress Test either before the encoding of emotional faces on their first visit or before recognition of emotional faces on their second visit or not stressed during either visit (control). The groups were split for testing in the morning vs. afternoon. While there was no main effect of stress on memory for emotional faces, under some conditions stress impaired recognition memory for neutral faces. Our data suggest that acute stress may have differential effects on recognition memory for emotional and neutral face stimuli.

G18

DEFICITS IN THE DETECTION OF TRUSTWORTHINESS AND ABERRANT SOCIAL INTERACTIVE DECISION-MAKING: EVIDENCE FROM PATIENTS WITH SCHIZOPHRENIA

Mascha van 't Wout[1,2], Alan Sanfey[2,3]; [1]Brown University, [2]University of Arizona, [3]Donders Institute for Brain, Cognition and Behaviour, The Netherlands — Schizophrenia is well-known to be associated with poor social functioning, and prior research has demonstrated social-emotional deficits thought to be due to dysfunction in brain areas supporting emotional processing. However direct evidence that difficulties in the processing of social-emotional information affects interpersonal functioning is lacking. One important social-emotional signal that has been shown to greatly influence social interactive decision-making is facial trustworthiness, a rapid, automatic, process which appears to rely on normal amygdala functioning. In this study we examined the hypothesis that patients with schizophrenia do not incorporate facial trustworthiness signals of others when playing social interactive games. Eight patients with schizophrenia and 19 control participants played a one-shot Trust Game with 16 partners previously (and independently) rated as untrustworthy and also with 16 partners rated as trustworthy. Correlational analyses showed that patients rated the trustworthiness of faces in a similar fashion to control participants ($r=0.84$, $p<0.001$), but deviate drastically from controls when judging the untrustworthiness of faces ($r=0.001$, $p=0.99$). Interestingly, both trustworthiness and untrustworthiness cues did not correlate with the decision on how much to trust another person in the Trust Game ($r=0.28$, $p=0.14$), a behavioral pattern that appears to be robust in non-schizophrenia participants ($r=0.8$, $p<0.001$). We conclude that even though patients are able to detect some aspects of trustworthiness, this social cue does not guide their decisions in a social context, thereby resulting in patients acting in a more economically advantageous manner.

G19

HOW DOES THE BRAIN PROCESS FEEDBACK ABOUT ITSELF?

Heather Mann[1], Graeme McCaig[1], Adi Steif[1], Kalina Christoff[1]; [1]University of British Columbia — Real-time fMRI is an emerging branch of neuroimaging, which allows people to view moment-to-moment feedback displaying fluctuating activations in their own brains. Real-time feedback can been used to train people to modulate activation levels in particular brain regions, a tool that bears promise for clinical interventions, for instance, training chronic pain sufferers to mitigate the acuteness of their pain experiences (deCharms et al., PNAS, 2005). However, real-time fMRI feedback introduces a paradox: the experience of viewing information about one's own brain activations must itself activate particular brain regions. If the target region for real-time training is sensitive to fluctuations in feedback valence, the effects of viewing positive or negative feedback could interact with the desired modulation, potentially compromising training. The present study investigates how viewing positive or negative real-time feedback influences whole brain activation patterns. Subjects viewed simulated real-time feedback on a fluctuating thermometer bar, which they believed to represent activity in their parahippocampal place area (PPA). The simulated feedback alternated between blocks of encouraging and discouraging feedback, which varied independently of a PPA modulation task. We found that shifts from positive to negative feedback were accompanied by increased activation in the anterior cinculate cortex (ACC). By contrast, shifts from negative to positive feedback were associated with activation of default mode network (DMN) regions, including the medial prefrontal cortex (MPFC) and posterior cingulate cortex (PCC). We conclude that positive feedback is likely to counteract down-regulation of DMN regions, suggesting that these regions are not amenable to real-time modulation training.

G20

VISUAL AND EXECUTIVE CORTEX POTENTIATION IN RESPONSE TO EMOTIONAL IMAGE STIMULI IMPLICITLY PRESENTED WITHIN A COGNITIVE-MOTOR CONTROL TASK

Michael Silverman[1], Ji-Yeoun Yoo[1], Xun Liu[1], Thomas Naidich[1], Martin Goldstein[1]; [1]Mount Sinai School of Medicine — Background: Several neurologic syndromes (e.g., ALS) are marked by aberration of cognitive-emotional integration required for adaptive behavioral regulation. While extensive prior studies have demonstrated differential neural activation in response to emotional stimuli, and the interaction of such stimuli with motor inhibition, implicit emotional activation concurrent with explicit cognitive control task demand (a real world-relevant challenge for neurologic syndromes) have been less well-investigated. Objective: To elucidate neural substrates of cognitive-emotional integrative failure across neurologic syndromes, we designed a novel neuropsychological visual image Go/No-Go activation paradigm, delivered within an fMRI protocol. Methods: 11 healthy right-handed subjects participated. Neuropsychological activation task involved serial presentation of emotionally-valenced images (IAPS) in a tilted or non-tilted manner. Discrimination of tilt/non-tilt attribute comprised basis of index finger Go/No-Go response selection. Task performance was concurrent with gradient EPI-BOLD fMRI. Image presentations were counterbalanced for valence type, arousal level, and presentation as Go/No-Go signal. SPM5 software was employed for image analysis using initial threshold of $p<.01$. Present study focused on differential neural responsivity to high- vs. low-arousal stimuli for purpose of validating this paradigm's implicit induction of emotional processing. Results: fMRI contrast of High- vs. Low-arousal image conditions revealed greater activation in bilateral prefrontal, bilateral occipito-temporal, and bilateral occipito-parietal cortices. Conclusion: Implicit emotional visual image processing concurrent to cognitive-motor control task performance recruited a distributed neural network including executive and visual (primary and associational) brain regions. These findings support validity of this paradigm for probing emotional arousal-dependent differences in neural function relevant to neurologic syndromes demonstrating cognitive-emotional integrative dyscontrol.

G21

MEMORY IMMERSION PRODUCES REDUCTION IN PAIN PERCEPTION

Damon Abraham[1], Jill Fischer[1], Robert Bosnak[1], Tor Wager[1]; [1]Columbia University — Pain is known to be influenced by many factors beyond the immediate physical stimulus. For instance, expectancies of drug effectiveness (placebo), expectancies about pain and its circumstance, anticipated rewards, self-efficacy beliefs, regulatory strategies, and other factors all may help shape the context in which pain is perceived. Supporting this assertion, previous research implicates several brain regions not directly associated nociception such as value processing (putamen, ventral striatum, caudate), cognitive control (DLPFC), and affective processing (DMPFC, pgACC) regions as mediators of these factors on pain reports. One interesting therapeutic technique used to treat pain in patients is a memory immersion paradigm, in which positive affect induced through therapist-guided autobiographical memory retrieval is believed to reduce painful sensation. It is unknown however, whether this reduction in pain is driven by the immersion therapy itself, or merely by factors of expectancy and relaxation. To test this hypothesis, participants were randomly assigned to an immersion condition described above or control. Control participants were provided with non-specific relaxation instructions that produced similar expectancies of analgesia as the immersion condition. Pain was administered by noxious thermal stimulation at low (pain sensation threshold), medium, and high (pain tolerance threshold) levels. Self-report and physiological measurements (skin conductance and heart rate) were obtained in response to thermal stimulation. As compared to the controls, memory immersion subjects showed a significant decrease in reported pain across all pain levels. These findings demonstrate top-down regulation of pain processing facilitated by the induction of positive affect through memory immersion.

G22

IMPAIRMENT IN WORKING MEMORY DUE TO SOCIAL EVALUATIVE THREAT IS MEDIATED BY ACTIVITY IN THE INTRAPARIETAL SULCUS Julie Spicer[1], Vanessa van Ast[2], Edward E. Smith[1], Sonja Schmer-Galunder[1], Tor D. Wager[1]; [1]Columbia University, [2]University of Amsterdam — Social evaluative threat (SET) is a potent stressor that can impair working memory (WM) and other cognitive processes, but the mechanisms by which it does so are poorly understood. Here we examine whether SET fundamentally alters WM performance, and if so, whether these alterations reflect changes in lateral prefrontal rehearsal and maintenance circuits, posterior cortical circuits involved in directing attention, "default mode" networks involved in task-irrelevant processes, or other areas. Twenty-one participants performed either a SET-eliciting task (delivery of a speech before a panel of evaluators) or a neutral control task (writing about a friend). WM performance and neural activity were subsequently assessed using an N-back task during fMRI scanning. Results indicate that cortisol increased in the SET group and that WM performance, as indexed by both accuracy and reaction time, was substantially impaired in the SET group. We searched for brain mediators of this effect using Mediation Effect Parametric Mapping. SET reduced N-back activity in lateral frontal, anterior cingulate and pre-supplementary motor area, lateral parietal cortex, and intra-parietal sulcus (IPS). Greater activation magnitude in many of these regions also predicted better WM performance across groups. However, only bilateral IPS mediated SET effects on performance. These results suggest that a basic attentional component of WM, rather than rehearsal or other components, may be particularly vulnerable to SET conditions.

G23

POSITIVE AND ANXIOUS MOOD MODULATES INFERENCE PRIMING DURING STORY COMPREHENSION Heather Mirous[1], Mark Beeman[1]; [1]Northwestern University — When people comprehending stories hear a premise state (John was wearing jeans) and later a changed state (John is wearing a tuxedo), they bridge this gap by inferring a causal connection (John changed). Drawing such causal inferences is often necessary to maintain coherence during language comprehension. Mood, whether assessed or induced, affects performance in a variety of cognitive tasks that likely share some component cognitive processes with drawing inferences. In the current set of behavioral studies, before participants listened to stories, we induced mood via film clips to examine the influence of positive affect and anxiety on drawing causal inferences. We contrasted priming of inference-related target words presented at an early time point (when the inference is predictive and optional) and a late time point (when a bridging inference is necessary to maintain story coherence) after each mood induction. Participants showed greater inference priming after positive mood induction than anxious or neutral mood induction, especially at the later time point. These results provide evidence that mood modulates inference processing during natural story comprehension, and suggests that mood may specifically influence the controlled process of inference selection (bridging point) compared to the automatic process of inference activation (predictive point). It is not yet clear whether mood is directly influencing the process of drawing inferences, or if the influence of mood is mediated through another cognitive mechanism, such as attention or working memory, which is under investigation. Though preliminary, these results may have implications for education as well as interpersonal communication.

G24

THE CONSTRUCTION OF VALENCE: ERPS TO NEUTRAL WORDS IN DISCOURSE MODULATED BY EMOTIONAL CONTENT OF PREVIOUS WORD OR SENTENCE Liam Clegg[1], Abigail Swain[1], Eric C. Fields[1], Nate Delaney-Busch[1], Daphne Holt[1,2,3], Gina Kuperberg[1,2,3]; [1]Tufts University, [2]MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging, [3]Massachusetts General Hospital — We used event-related potentials (ERPs) to examine the influence of emotionally-valent adjectives on processing subsequent words in two-sentence scenarios (e.g. "The students gave the professor enthusiastic/biting/periodic evaluations. Their feedback was read by him."). The first sentence included a positive ("enthusiastic"), negative ("biting") or neutral ("periodic") adjective which modified a direct object ("evaluations") at the sentence-final position; the second sentence began with a neutral noun-phrase anaphor referring back to the direct object ("Their feedback"), and ended with a pronominal anaphor referring back to one of the characters in the first sentence ("him"). To ensure deep processing, participants produced a single sentence, extending the narrative they had just read. To determine the immediate effect of emotional valence, ERPs were measured on the adjective in the first sentence. Both negative and positive adjectives evoked a larger late positivity than neutral adjectives. Negative adjectives also evoked a larger centrally-distributed negativity between 350-450ms than neutral adjectives, while nouns following positive adjectives evoked a widely-distributed N400 effect. The influence of emotional valence persisted across clause boundaries: (1) Anaphors referring back to emotionally-modified nouns evoked a larger late positivity than those referring back to neutral nouns, and (2) sentence-final pronouns that followed negatively valenced first sentences evoked a larger centrally-distributed positivity, beginning at 300ms, than those following neutral or positive first sentences. These findings indicate that emotional valence has immediate impact on online neural mechanisms of language processing, both within and across clause boundaries.

G25

ESTRADIOL MODULATES EMOTIONAL MEMORY ENCODING IN YOUNG WOMEN Amanda Kutz[1], Christina Broadwell[1], Heather Wilkins[2], Ashley Pfaff[1], Paul Newhouse[1], Julie Dumas[1]; [1]University of Vermont, Burlington, VT, [2]Washington University, St. Louis, MO — Prior literature shows that endogenous variability in estradiol during the menstrual cycle is related to changes in amygdala activation while viewing emotional pictures. Evidence also shows that amygdala activation correlates with improved memory in an emotional memory task. The current study examined emotional memory at different times during the menstrual cycle to investigate the effects of estradiol variability on emotional memory and related brain activation. Ten healthy young women completed the study protocol once in the early follicular phase when estradiol levels were low and once around ovulation when estradiol levels were high. Using event-related functional magnetic resonance imaging (fMRI) women viewed emotionally negative and neutral words from the ANEW database during an encoding task. Recognition memory was tested at the end of the scanning session and measures of subsequent memory were used to examine brain regions activated during encoding of emotional pictures. Results showed that while there were no significant differences in recognition performance across the menstrual cycle, imaging data suggest differential patterns of activation at these two time points. Around ovulation when estradiol levels were high, greater activation in frontal regions during successful encoding emotional stimuli was noted. In the early follicular phase when estradiol levels were low , greater activation in the amygdala during successful encoding of emotional stimuli was demonstrated. These data suggest that emotional encoding is modulated by estradiol fluctuation during the menstrual cycle and may influence how the brain responds to emotional information.

G26

NEURAL CONNECTIVITY AT ENCODING PREDICTS SELECTIVE MEMORY FOR EMOTIONAL SCENES Jill Waring[1], Elizabeth Kensinger[1,2]; [1]Boston College, [2]Athinoula A. Martinos Center for Biomedical Imaging — Emotionally arousing visual scenes are remembered better than neutral scenes, but not all portions of emotional scenes are remembered with the same accuracy. Although memory for emotionally arousing items is enhanced relative to neutral items within scenes, memory is often impaired for peripheral background information contained within emotional scenes, known as a trade-off effect. In this study, we examined the effective connectivity at encoding predicting a trade-off in memory for high arousal emotional scenes. In an event-related fMRI study, young adults viewed scenes containing high arousal positive and negative items, and neutral items placed upon neutral backgrounds. Later, outside the scanner, participants completed a surprise recognition memory test, with the items and backgrounds from the scenes presented independently. Subsequent memory design allowed us to measure the neural activity predicting a memory trade-off compared to later remembering both the emotional item and background from the scene. To better understand the pattern of neural activity associated with this effect, we modeled the effective connectivity between regions. Regions included in the anatomical model were identified in whole-brain analysis comparing the neural response to viewing all scene types versus a fixation cross, and selected for their theoretical relevance to encoding of emotional information. Results revealed that greater connectivity between the amygdala and limbic regions and the inferior frontal gyrus predicted when participants would later remember only the emotional item, compared to later remembering both the emotional item and its background. These results demonstrate stronger neural connectivity at the encoding stage predicts selective emotional memory.

G27

DO APPRAISALS INFLUENCE THE RELATIONSHIP BETWEEN STRESS AND MEMORY? Roxanna Salim[1], Nicole Y. Weekes[2]; [1]Claremont Graduate University, [2]Pomona College — Numerous studies have demonstrated stress affects memory functioning. However, stress is not only determined by the circumstances of the external environment but also by how the individual perceives the stressor and more specifically whether one appraises the stressor as a threat or a challenge. While previous research has investigated the relationship between stress and memory, the specific relationship between appraisals and memory has yet to be observed. In the present study, 55 undergraduate participants were presented with the Trier Social Stress Test, a number of psychological and physiological stress measures, and pre and post stress declarative memory tasks. Results indicate that participants showed a significant increase in the face of the stressor, and threat appraisals negatively influence memory performance.

G28

THE GOOD, THE BAD AND THE MEAN: BRAIN SIGNATURES OF EMOTIONAL BIOGRAPHICAL KNOWLEDGE IN FACE RECOGNITION Rasha Abdel Rahman[1], Julia Junker[1]; [1]Humboldt University, Berlin — Extracting meaning from emotional facial expressions to understand other people's mental states and feelings, and to quickly adjust our actions accordingly, is a vital aspect of social interaction. However, not all emotionally relevant attributes of a person are directly observable. In this study we used event-related brain potentials to investigate the effects of emotionally significant stored information about a person's biography that cannot be derived from vision. Faces of familiar and initially unfamiliar persons with neutral expressions were associated with negative, positive or emotionally neutral biographical information. The observed ERP modulations associated with emotional knowledge, their scalp topographies and time course strongly resemble the effects frequently reported for emotional facial expressions even though here, access to stored semantic knowledge is required. In sum, the results demonstrate that visually opaque emotionally valent semantic knowledge is extracted at high speed and facilitates sensory processing in the visual cortex.

G29

EMOTION PROCESSING DEFICITS IN PSYCHOMETRICALLY MEASURED SCHIZOTYPY Nicole Karcher[1], Jeri Kent[1], Jennifer Stevens[1], Glenn Shean[1]; [1]College of William and Mary — Schizotypy, or the personality characteristic of psychosis proneness, is associated with a broad range of emotional deficits, including emotion processing. While previous research has established the existence of these emotion processing deficits, few studies have delved into the basis of these deficits. The current study aims to use event-related brain potentials (ERPs) in order to explore the neural correlates of emotion processing deficits in schizotypal individuals. Undergraduates were selected to participate based off of scores from the Magical Ideation Scale. These scores revealed a group of participants who indicated high levels of schizotypy (n=18), as well as a control group with low levels of schizotypy (n=20). Participants viewed neutral, positive, negative, and emotional valenced images while EEG was recorded. The results indicate that differences between the two groups as measured by additional schizotypy questionnaires were statistically significant. In addition, there were significant differences between the two groups in the P300 amplitude response to emotional images. Specifically, there was a striking trend of a decreased P300 amplitude in individuals scoring high in measures of schizotypy. There also appears to be preferential emotional processing in the right parietal hemisphere in these individuals. The results indicate that schizotypal individuals display complicated combination of attenuated attentional allocation to emotional stimuli as well as an increased vigilance towards and in response to threat. The P300 amplitude deficits also indicates the possibility that these results may have been obtained due to a broader information processing deficit in individuals scoring high in measures of schizotypy.

G30

A BENEFIT FOR ATTENTION ALLOCATION TO ANGRY FACES FROM THE DEPLETION OF CENTRAL RESOURCES? EVIDENCE FROM EVENT-RELATED POTENTIALS Annekathrin Schacht[1], Julian Rellecke[1], Werner Sommer[1]; [1]Humboldt University, Berlin — Several studies have shown emotional facial expressions to involuntarily draw attentional resources, resulting in a preferential and sustained processing. However, as yet it remains unclear, under which specific conditions emotional processing depends on the availability of central attentional resources. In the present study, we investigated whether processing of task-irrelevant emotional facial expressions depends on the availability of central attention resources, using a dual-task paradigm. Twenty-four participants performed a high-priority tone discrimination (T1) in combination with a gender classification of faces (T2) with happy, angry, and neutral expressions. Availability of central resources was manipulated by varying the stimulus onset asynchrony (SOA) between tasks. Angry faces elicited an enhanced early posterior negativity (EPN) in event-related brain potentials. The EPN was largest at the shortest SOA. Therefore, fast reflexive attention to angry emotional expressions, as indicated by the EPN, appears to benefit from the withdrawal of central resources. This finding is in line with a release from suppression of irrelevant emotional information when central resources are allocated to other high-priority processes.

G31

HUMANS SHOW CONTEXTUAL EFFECTS IN FOOD PREFERENCE CONDITIONING Sarah Davies[1], Isabelle Blanchette[2], Liesbeth Zandstra[3], Wael El-Deredy[1]; [1]The University of Manchester, UK, [2]Université du Québec à Trois-Rivières, Canada, [3]Unilever Research and Development Vlaardingen, The Netherlands — Animal and human studies show food preferences can be learnt through a process of evaluative conditioning (EC). Studies have shown that in rodents, food preference conditioning can be mediated by contextual factors (e.g. location) such that a stimulus can be liked in one context and disliked in another. Little research has, however, been carried out to investigate context effects in human food preference conditioning. This experiment aimed to investigate the effect of an internal contextual factor, attitudes, on food preference conditioning in humans. A differential flavour-flavour evaluative conditioning paradigm was used in a balanced cross-over design. Participants (n=33) were exposed to three novel CS flavoured drinks; one consumed in compound with a pleasant US (CS+ sugar), one with an aversive US (CS+ saline) and a third with plain water (CS-). Each CS+/- was sampled ten times. Attitudes were also manipulated by exposing participants to positive, neutral or negative information paired consistently with one of the CS+/-. Results showed a significant increase in preference for CS flavours paired with sugar and a decrease for CS flavours paired with saline. A significant interaction between US type and attitude type showed conditioning effects were greater in the positive attitude condition than the negative attitude condition. Results from this experiment suggest that attitude can influence the extent to which food preference conditioning occurs.

G32

UNCONSCIOUS AFFECTIVE PRIMING OF THERMAL PAIN: EFFECTS OF SUBLIMINAL AFFECTIVE STIMULI DEPEND ON BOTH VALENCE AND TEMPERATURE Joseph Wielgosz[1], Lauren Atlas[1], Damon Abraham[1], Tor D. Wager[1]; [1]Columbia University — Subconscious priming is known to modulate semantic, perceptual, and affective processes. Meanwhile, overt presentations of emotional images have ben shown to modulate pain reports and responses in relevant brain regions. We investigated whether minimal affective stimulation, via subconscious perception of masked emotional faces, influences pain. In study 1, we presented masked fearful and happy faces at the start of an anticipation period, and examined trial-by-trial pain reports for four levels of subsequent noxious thermal stimulation. Pain reports were modulated by both prime valence and stimulation temperature: at low temperatures, subjects reported less pain when primed with fearful faces relative to happy faces. This effect was abolished under high pain stimulation. In study 2, we added a neutral face prime, and a task measuring ability to discriminate between primes. Study 2 replicated the low-temperature priming effect. Signal detection analyses revealed this effect to be independent of subjects' ability to consciously discriminate between primes. Accounting for detection, we found that the effect was driven more by fearful faces: subjects reported less pain after fearful than neutral faces, while no differences were found for neutral relative to happy faces. Pain experience therefore appears sensitive to minimal affective cues in the environment, via an automatic pathway. The observed pattern may implicate the amygdala, where activity increases during perception of fearful faces, while decreasing during pain. Functionally, such a process may serve in preparing for anticipated pain, or in shifting attentional focus towards potential threat in the external environment and away from the body.

G33

DISSOCIATIONS IN THE EXPERIENCE, RECALL, AND VALUATION OF PAIN Jenna M. Reinen[1], Tal Yarkoni[1,2], Damon Abraham[1], Tor Wager[1]; [1]Columbia University, [2]Unversity of Colorado, Boulder — Decision making research has demonstrated that the most intense and final moments of a painful experience contribute disproportionately to memories that influence related choice behavior ('peak-end' rule; Redelmeier & Kahneman, 1996). The present study sought to replicate and extend these findings at both within-subject and between-subject levels of analysis in the domain of thermal pain. Participants (N = 18) experienced a series of painful stimulations that varied in intensity and shape while providing both moment-by-moment and retrospective pain ratings. Subsequently, we obtained willingness-to-pay (WTP) estimates of the monetary value participants assigned to each pain stimulus. An analysis of pain ratings and valuation as a function of temperature (high/moderate), duration (long/short) and number of peaks (one/two) revealed a complex pattern whereby pain perception depended heavily on peak ratings and to a lesser extent on duration. Moreover, the influence of duration on perceived pain was substantially attenuated during double-peaked stimulations relative to single-peaked stimulations. We interpret the latter finding with reference to offset analgesia, a profound, active state of pain relief associated with significant reduction in pain following small decreases in intensity. Thus, these results suggest the "peak-end rule" may reflect relatively low-level active relief processes rather than late-stage memory distortions. Overall, our data supports the theory that the peak level of reported thermal pain contributes disproportionately to memory and valuation of pain. Future studies should further explore the relative contributions of neural correlates of offset analgesia (e.g., periaqueductal gray and medulla) and event segmentation as possible mediators of the peak-end effect.

G34

EXPECTANCY-BASED ENHANCEMENT OF OPIOID ANALGESIA: AN FMRI STUDY OF HIDDEN VS OPEN REMIFENTANIL ADMINISTRATION Lauren Atlas[1], Robert Whittington[1], Nomita Sonty[1], Tor Wager[1,2]; [1]Columbia University, [2]University of Colorado, Boulder — It has long been believed that expectancies enhance the effects of active pharmacological treatments. For example, open-label administration of analgesic drugs, which enhances expectations of relief, can produce substantially greater pain relief than administration without a patient's knowledge. Though research suggests that common brain regions are influenced by both placebo and opioid treatments, it is unknown whether knowledge of drug delivery specifically enhances drug effects on the brain. We used pharmacological fMRI to compare the effects of overt versus covert administration of remifentanil, a potent opiate analgesic, on brain responses to noxious thermal stimulation. Two identical drug infusions were delivered to each participant: In one condition, participants knew the infusion would be delivered ("Open"), and in the other, they were led to believe that they would be receiving saline ("Hidden"). Remifentanil reduced reported pain during painful stimulation, and the reduction was greater with Open than Hidden administration. Consistent with these effects, remifentanil reduced pain-evoked responses in several key elements of the PPN—dorsal anterior cingulate, anterior insula, and thalamus—and these reductions were enhanced during Open administration. In addition, Open administration was accompanied by larger drug-induced increases in regions involved in value and appraisal (medial orbitofrontal cortex, striatum, and dorsomedial prefrontal cortex). Together, these results suggest that knowledge of drug delivery and the accompanying expectations for relief enhance the analgesic effects of remifentanil. More broadly, they point to the potential for placebo-drug synergies in other drugs and domains as well, and suggest that expectancies should be considered in clinical pharmacological research.

G35

THE TIME COURSE OF AUTOMATIC PROCESSING FOR NEGATIVE EMOTIONAL STIMULI WITH UNATTENDED CONDITION: EVIDENCE FROM FUNCTIONAL DATA ANALYSIS AND ERPS Renlai Zhou[1,2], Xiaonan Liu[1], Yansong Li[1], Minqiang Zhang[3], Can Jiao[4], Minping Xiong[3]; [1]State Key Laboratory of Cognitive Neurosciences and Learning, Beijing Normal University, China, [2]Research Center for Learning Science, Southeast China University, [3]South China Normal University, Guangzhou, China, [4]Shenzhen University, China — The research aimed to examine if the processing of unattended fearful faces was influenced by perceptual load of ongoing tasks, and the interference effect of facial expression on ongoing task would be decreased when presentation time was changed. The research combined behavioral methods with ERP techniques. Participants were asked to judge structures of Chinese character for low perceptual load task and judge tunes for high load task. The presentation time in behavioral experiments was ranged from 90ms, 100ms, 130ms, 150ms, 200ms to 220ms and from 100ms, 170ms to 200ms in ERP experiments. The behavioral results showed that the interference effect of fear expression was observed in low perceptual load when the presentation time was ranged from 100ms to 200ms and in high load when the presentation time was ranged from 150ms to 200ms. The interference effect of fearful expression disappeared when the presentation time was 90 ms and

220ms in both tasks. The functional data analysis which assume the reaction time among different time points were acquired by the same group showed that 170ms was the lowest point of interference effect. The ERP results showed that the amplitude of P2 elicited by fear condition was significantly larger in 100ms experiment. In 170ms and 200ms, there was no significant difference of P2. The processing of negative stimuli under inattention was modulated by the availability of attention resource, and 170ms was the lowest point of interference effect.

G36

FINDING THE FLASHBULB'S FLASH: EMOTIONAL AROUSAL ENHANCES SUBJECTIVE AND NEURAL CORRELATES OF PERCEPTUAL VIVIDNESS Rebecca M. Todd[1,2], Adam K. Anderson[1,2]; [1]University of Toronto, [2]Rotman Research Institute — The emotional spotlight cast on salient events — the perceptual "flash" associated with "flashbulb" memory — may enhance encoding of emotional events as well as subsequent memory. The goal of the present study was to examine the psychophysical and electrophysiological bases of the perceptual vividness of emotionally arousing events. To measure the phenomenological vividness of perceptual experience, we employed a magnitude estimation procedure and manipulated the amount of visual signal relative to noise in emotionally arousing and neutral scenes by overlaying the scenes with randomly distributed pixels. In order to pinpoint the timing of cortical responses related to perceptual vividness, we collected ERP data while participants estimated the relative degree of "noisiness" of each picture. Participants could accurately distinguish objective levels of noise; however, at any given level of objective noise, emotionally arousing images were perceived as less noisy — or more perceptually vivid — than neutral images. Further analyses revealed that emotional salience enhanced the experience of perceptual vividness above and beyond vividness associated with objective physical differences between images. ERPs measured at occipitoparietal sites showed a positive peak at 200-250 ms after stimulus presentation (P2) that was larger for more arousing images and smaller for higher levels of objective physical noise, suggesting sensitivity to perceptual vividness between 200 and 300 ms. These results suggest that reentrant influences on posterior cortical activity related to enhanced vividness are observed as early as 200 ms, and may represent the cortical "flash" supporting the perceptual enhancement of emotionally arousing events.

G37

COGNITIVE MODULATION OF STIMULUS VALUES AT THE TIME OF DECISION MAKING Cendri Hutcherson[1], Hilke Plassmann[2], James Gross[3], Antonio Rangel[1]; [1]California Insitute of Technology, [2]Insead, [3]Stanford University — Research on the neurobiology of emotional regulation has illuminated how emotional responses to negative stimuli are regulated. However, little is known about how people regulate reactions to appetitive stimuli to influence choice. We investigated this question using a modified version of the food bidding task in Plassmann et al. 2007. Subjects were trained to use three types of regulatory strategies when placing bids in the scanner for the right to eat different foods at the end of the experiment: (1) natural response (2) indulgence, and (3) distancing. We examined the impact of regulatory strategy on activity in regions implicated in cognitive control and emotion regulation, such as the ventrolateral prefrontal cortex (vlPFC, Ochsner et al., 2005), as well as in regions implicated in value computation, such as the medial orbitofrontal cortex (mOFC) and amygdala. We found that both indulgence and distancing increased activation of the vlPFC, but that this lead to different outcomes in the two conditions. During distance trials the vlPFC exhibited negative functional connectivity with the mOFC, which in turn showed reduced responsivity to the foods, as compared to natural and indulge trials. In contrast, during indulgence trials, the vlPFC showed stronger positive coupling with the amygdala, which in turn was more responsive to foods than during natural or distancing trials. These results suggest that participants can use cognitive strategies to modulate the value signals that are assigned to stimuli at the time of choice, but that the networks involved might depend on the regulatory goals.

G38

DISSOCIATION OF SOCIAL AND NON-SOCIAL REWARD PROCESSING IN AUTISM Alice Lin[1], Antonio Rangel[1], Ralph Adolphs[1]; [1]California Institute of Technology — Impairments in social functioning are core features of Autism Spectrum Disorder (ASD). Individuals with ASD do not show the same early preference for faces and voices and often have difficulty extracting the affect expressed through these cues. One theory, the social motivation hypothesis, suggests that deficits in social cognition could result from impairments in social reward processing. Decreased social motivation would result in reduced attention to faces, voices, and hand gestures, which in turn would lead to failure to develop efficient expertise ability to process social stimuli. High-functioning individuals with ASD and neurotypical matched-control subjects chose between slot machines characterized by different distributions of positive, neutral, or negative outcomes; these outcomes were smiling, neutral, or angry faces with matching sound effects in a social condition, and +$1, $0, or -$1 in a monetary condition. Neurotypical subjects learned to differentiate behaviorally between high and low rewarding slot cues in both conditions so as to maximize rewarding outcomes. By contrast, ASD subjects performed similarly to neurotypicals only on the monetary condition but exhibited a gross learning deficit in the social condition. This striking behavioral dissociation allowed us to probe the underlying neural differences in social and non-social reward processing. In a separate fMRI study, we found evidence for both shared and segregated neural substrates for processing social and nonsocial reward. Results not only lend support for the social motivation hypothesis, but provide further insight into social reward processing and have implications in the development of therapeutic interventions for autism.

G39

REWARD PROCESSING IN SUBSYNDROMAL HYPOMANIA: ERP DIFFERENCES IN A COMPUTERISED GAMBLING TASK Wael El-Deredy[1], Liam Mason[1], Richard Bentall[2], Isabelle Blanchett[3]; [1]School of Psychological Sciences, University of Manchester, England, [2]School of Clinical Psychology, Bangor University, Wales, [3]University of Quebec, Canada — Reward processing is known to be altered in patients suffering from Bipolar Disorder (BD). In particular, heightened reward responsiveness underlies increased engagement in hedonic activities and risk-taking seen during episodes of mania, whilst the converse is seen during episodes of depression. These two observations have given rise to reward dysregulation accounts of BD. Both manic and depressive symptoms lie on a continuum, extending into the general population. Whilst much work tested this account behaviourally, there is a paucity of research taking a neuroscientific approach. This study aimed therefore to characterise differences in the electrophysiological correlates of reward processing in a sample exhibiting subsyndromal hypomania symptoms. We recorded EEG during a computerised gambling task involving probabilistic learning. Participants learned reward contingencies of three cues with 20%, 50%, or 80% chance of rewarding outcome, and used this to guide their bet sizes. Participants were divided into low, medium and high groups based on scores on Hypomanic Personality Scale (HPS). We found significant differences in P300 magnitude between low and high hypomania groups for reward trials, with larger P300 in high scorers. Furthermore P300 amplitude positively correlated with HPS score. The P300 has been reliably shown to reflect reward processes, encoding expectancy and both valence (gain/loss) and magnitude (small/large) properties of reward-related stimuli. These findings from a clinical neuroscience approach support the hypothesis that a hypersensitive reward system underpins the excessive engagement in pleasurable activities typical during manic episodes. Future work will explore between-group spatial differences in the neural generators of this waveform.

Methods: Electrophysiology

G40

PARANOID FEELINGS OF HEALTHY INDIVIDUALS AND DELUSIONAL BELIEFS OF SCHIZOPHRENIA PATIENTS: A COMMON NEUROCOGNITIVE PROCESS? Lujaien Al-Rubaiey Kadhim[1], Marie Prevost[1], Sherisse McLaughlin[1], James Zhang[1], J. Bruno Debruille[1]; [1]Douglas Institute, McGill University — Traditionally, paranoia is viewed as a pathological feature; however, recent evidence suggests that paranoia may lie on a continuum with normal behavior. The present study examined whether inducing paranoid feelings in healthy individuals (HIs) would result in smaller N400 amplitudes similar to those found when comparing More- to Less-delusional schizophrenia (Sz) patients. Method: 52 HIs first completed the Schizotypy Personality Questionnaire to measure their delusional-like ideation. Their ERPs were recorded during a semantic task and paranoid feelings were induced by telling participants that we may emit small and harmless currents to temporarily modify their brain function. Results: Paranoid levels were significantly increased by the induction ($p = .004$). At lateral electrodes, More Delusional subjects had lower N400 amplitudes than Less Delusional subjects ($F1,48 = 4.14$, $p = .047$). Similar trends were found for sagittal and parasagittal sites ($F1,48 = 2.94$, $p = .093$ and $F1,48 = 3.57$, $p = .065$, respectively). Furthermore, higher levels of delusion were associated with lower N400 amplitudes at Cz ($p = .041$), O1 ($p = .043$), P3 ($p = .022$), T5 ($p = .045$) and T6 ($p = .045$) in the match condition and O1 ($p = .028$) and T5 ($p = .026$) in the mismatch condition. Conclusion: The results replicate those of a previous study in HIs and confirm commonalities in the neurocognitive processes of HIs during an active state of paranoia and those of Sz patients, also suggesting that delusions and the cognitive abnormalities associated with them are states rather than traits.

Language: Semantic

G41

HOW SPECIFIC ARE ACTION VERBS REPRESENTED WITHIN THE NEURAL MOTOR SYSTEM? Shirley-Ann Rueschemeyer[1], Wessel van Dam[1], Harold Bekkering[1]; [1]Donders Centre for Cognition, Radboud University — Numerous studies have demonstrated that understanding words activates neural resources involved in the perception of a word's referent (i.e., embodied cognition). For example, it has been shown that neural motor areas (i.e., areas involved in co-ordinating the execution of actions) are activated when a participant listens to or reads words denoting motor acts (e.g., grasp, kick). It remains unclear how specific semantic features are represented within perceptual and motor systems. Previous research suggests that within the visual modality, basic level category members (e.g., bird) are less richly encoded within primary visual cortices than members of the subordinate level (e.g., penguin). In the present study we were interested in whether we could extend these observations to the motor domain. To this end, we measured BOLD-response to verbs that were associated with a general motor program (e.g., to clean) or with a more specific motor program (e.g., to wipe). We hypothesized greater activations for action verbs associated with a more specific motor program in both the left ventral premotor cortex and the left inferior parietal cortex. A preliminary regions of interest (ROIs) analysis revealed that fMRI activations in both ROIs were sensitive to the specificity of the motor programs associated with the action verbs. Action verbs that are associated with a specific motor program showed greater activations in both the left vPMC and the left IPL. Beyond previous research, these findings suggest that the concreteness of an action semantic feature is reflected in the neural response to action verbs.

G42

COMPREHENDING FAMILIAR AND UNFAMILIAR METAPHORS Els Severens[1], Sarah Bernolet[1], Wouter Duyck[1]; [1]Ghent University — The present ERP-study investigated the comprehension of familiar and unfamiliar metaphors within a sentence context. The focus of previous research investigating metaphor comprehension was mainly on conventional (familiar) metaphors. Recently, Arzouan, Goldstein and Foust (2007) carried out an ERP-study to investigate the comprehension of familiar and unfamiliar metaphors. They found a modulation of the N400, with a larger amplitude for unfamiliar metaphors. In their study metaphors only consisted of two words, thus there was no context to comprehend the metaphors. In daily life metaphors are mainly comprehended within a specific context. Therefore, we added a context sentence to investigate the comprehension of familiar and unfamiliar metaphors. The sentences were first rated on familiarity, based on these ratings familiar and unfamiliar metaphors using the same word as metaphor were selected for the experiment. During the ERP-study participants had to read both kinds of metaphors and control sentences in which the critical words were used in their literal meaning and as an anomalous word. The results showed a modulation of the N400 amplitude, the smallest N400 was obtained in the literal sentence, with increasing amplitudes for the familiar metaphors, unfamiliar metaphors and the anomalous sentences. These results show that integration of the familiar metaphor is easier than integration of the unfamiliar metaphor. Furthermore, it is easier to integrate the unfamiliar metaphor than the anomalous word, which suggests that the activation of the metaphorical meaning helps to integrate the critical word in the unfamiliar metaphor.

G43

INVESTIGATING THE RELATIONSHIP BETWEEN SPEECH RHYTHM AND SEMANTIC PROCESSING Kathrin Rothermich[1], Sonja Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, IRG Neurocognition of Rhythm in Communication — In trochaic languages such as German, the alternation of stressed and unstressed syllables (termed 'meter') is very prominent, and can function as a temporal and structural cue in sentence processing. The current experiment investigated semantically, metrically, and doubly violated sentences to examine whether (1) the 'metric' negativity (i.e. Schmidt-Kassow and Kotz, 2009) interfaces with the N400 when manipulating semantic expectancy, (2) this potential interface is influenced by task demands, and (3) the N400 (indexing lexical-semantic integration) is affected by metric regularity. Our results show that semantic expectancy violations elicit the expected N400, whereas metric violations elicited a biphasic pattern consisting of the 'metric' negativity and a P600. The 'metric' negativity differs from the classical N400 in terms of its latency and distribution suggesting that the two components reflect different processing mechanisms. Furthermore, the N400 and the P600 are only evoked when attention is focused on semantics and meter, respectively. However, lexical-semantic processing in metrically regular compared to metrically variant sentence context is facilitated as evidenced by a reduced N400 response to semantic expectancy violations. This finding suggests that the nature of metric sentence structure impacts lexical-semantic integration.

G44

USING DICHOTIC AND CROSS-MODAL PRESENTATION TO STUDY HEMISPHERIC DIFFERENCES IN MEANING ACCESS Ruth Ann Atchley[1], Jonathan Schuster[1], Linzi Gibson[1], Gina Grimshaw[2]; [1]University of Kansas, [2]Victoria University, Wellington — The present studies investigated hemispheric differences in the processing of lexically ambiguous words presented dichotically and using a cross-modal presentation paradigm. We predicted that words presented via the auditory modality would replicate earlier findings from the divided visual field language literature showing a left hemisphere (LH) advantage for accessing the dominant meanings of words and a right hemisphere (RH) advantage for accessing more remotely associated word meanings. We tested eighty-six undergraduates across two studies (one study with a binaural prime and dichotically presented targets and one study with visually presented primes and dichotically presented targets) using a modified lexical decision task. The results are generally comparable with previous visual word presentation, laterality research. In both studies, the right ear/LH data showed priming for the dominant meaning of the ambiguous words, but no priming for subordinate word meanings. In contrast, the left ear/RH trials showed evidence of equal access to the two meanings of the ambiguous word in the purely auditory study and an advantage (as reflected by significantly faster response times) for the more subordinate word meaning only in the cross-modal study. Our results provide information about how dichotic methods might be effectively applied to address laterality models of semantic processing.

G45

ABSTRACT AND CONCRETE NOUN PROCESSING IN HEALTHY OLDER ADULTS USING FMRI Chaleece Sandberg[1], Swathi Kiran[1]; [1]Boston University — Normal subjects and persons with aphasia exhibit a 'concreteness effect' during a variety of lexical tasks. Recent evidence from neuroimaging studies suggests possible dissociable neural correlates for processing abstract versus concrete words. Specifically, abstract words are processed in a left-lateralized 'verbal' network and concrete words are processed in a bilateral 'perceptual' network (Binder, Desai et al. 2009). However, the vast majority of these studies have been conducted with healthy young adults. The current study examined the neural activation patterns of abstract and concrete word processing in healthy older adults in order to help establish a baseline against which neural activation patterns of abstract and concrete word processing in persons with aphasia could be compared. Ten (five male, five female) monolingual, right-handed adults aged 50-63 with no history of neurological disease each completed both a lexical decision task and a word judgment task in an fMRI scanner. During the lexical decision task, both concrete and abstract nouns produced bilateral activation, with greater overall activation for concrete nouns. During the word judgment task, abstract nouns produced greater overall activation and more bilateral activation than concrete nouns, which produced more left-hemispheric activation. These tentative results indicate that a) neural activation patterns for concrete versus abstract words may be task-specific, and b) healthy older adults may process abstract and concrete words differently than healthy young adults. These results may influence analyses of abstract and concrete processing in persons with aphasia.

G46

ACTION VERBS DO NOT ALWAYS ELICIT EFFECTOR-SPECIFIC PREMOTOR CORTEX ACTIVATION: IMPLICATIONS FOR EMBODIED LANGUAGE UNDERSTANDING Roel Willems[1,2], Martin Laverman[2], Peter Hagoort[2,3], Daniel Casasanto[3]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley, [2]Donders Institute, Nijmegen, [3]Max Planck Institute for Psycholinguistics, Nijmegen — The cortical motor system has been implicated in understanding of action-related language such as action verbs like 'kick' and 'throw'. Indeed previous research shows that reading such action verbs leads to effector-specific activations in premotor cortex, with cortical tissue which is involved in execution of for instance hand movements also being sensitive to reading of verbs implicating hand actions. On some proposals these premotor activations are regarded as a crucial part of an action verb's representation, occurring invariantly and independent from linguistic context or task. We directly tested if effector-specific premotor cortex activations always occur when reading action verbs. Healthy participants read verbs expressing actions performed with the hand ('throw') or with the feet ('kick'), while they performed an abstract/concrete judgment task. Verbs were presented eight times within an experimental session. Effector-specific regions were determined by means of an action execution task in which participants performed simple hand or foot movements. The results show that parts of premotor cortex distinguishing hand from foot actions also distinguish hand from foot verbs, but only for the first presentation of a verb. When a verb is read after its first presentation, these areas do not distinguish hand from foot verbs anymore. This means that effector-specific premotor cortex activation during language understanding is not an invariant property of a verb's representation but that it is flexible, at least depending upon the number of presentations during an experimental session.

G47

DISSECTING EMBODIED COGNITION: SOMATOTOPIC-SEMANTIC PROCESSING IN THE FRONTO-CENTRAL NETWORK Carrie Esopenko[1], Jacqueline Cummine[2], Naila Kulhmann[1], Gordon Sarty[1], Ron Borowsky[1]; [1]University of Saskatchewan, [2]University of Alberta — Embodied cognition suggests that cognition is bodily based, and that the brain developed as a function of interaction with the environment, thus evolving to facilitate sensorimotor processing (e.g., Gibbs, 2006; Wilson, 2002). Recent neuroimaging research has shown a somatotopic-semantic organization in the fronto-central regions during the processing of action-related language (e.g., Esopenko, et al., 2008; Hauk, et al., 2004). Our experiment used functional magnetic resonance imaging to examine blood oxygenation level dependent (BOLD) characteristics (i.e., width, time to peak, intensity and volume) as they relate to behavioural response time ("how would you use the object the word refers to?"). By using stimuli that involve either arm or leg interactions, we also explored the extent to which the fronto-central regions are organized somatotopically. Our results show semantic-somatotopy in the fronto-central network for arm and leg stimuli. Regression of leg stimulus response time (RT) onto BOLD characteristics revealed significant: (1) negative relationship between RT and BOLD width in the middle temporal gyrus (MTG), premotor cortex (PMC) and supplementary motor area (SMA), (2) positive relationship between RT and BOLD time to peak in the MTG, PMC, and SMA, and, (3) positive relationship between RT and volume in the PMC and SMA. Arm stimuli did not yield any significant relationships between RT and BOLD characteristics. An analysis of the time to peak of the BOLD signal shows that activation in MTG asymptotes sooner than activation in PMC and SMA. These results will serve to advance models of the relationship between semantic processing and neurophysiology.

G48

THE EFFECTS OF SEMANTIC AND PHONOLOGICAL AMBIGUITY ON PROCESSING SPOKEN WORDS: BEHAVIOURAL AND NEURAL EVIDENCE Jack Rogers[1], William Marslen-Wilson[1], Matthew Davis[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge — Recent evidence suggests that the anterior and posterior left inferior frontal gyrus (LIFG) may play a role in semantic and phonological processing respectively (Poldrack et al., 1999). However, it is unclear whether this specialisation reflects a task-specific role within inferior frontal regions. Here we assess the effect of semantic and phonemic ambiguity on lexical processing using single spoken words. Lexical decisions to semantically ambiguous spoken words (bark and knight/night) revealed significantly slower RTs compared to matched controls (bed). Lexical processing of phonemically ambiguous syllables was assessed by creating natural sounding morphed speech continua using "Straight" software (Kawahara et al., 1999). Participants heard either a single high-ambiguity (35% or 65% morph) or low-ambiguity (5% or 95% morph) syllable created from mixing two words (porch-torch), two non-words (pash-tash) or a word and a non-word (punt-tunt, poy-toy). Lexical decision responses showed an effect of ambiguity for words but not for non-words. Using a sparse imaging design and a simple semantic target detection task we assessed the neural correlates of the semantic and phonological ambiguity effects seen behaviourally. Semantically ambiguous versus unambiguous single words produced increased activation within regions of anterior LIFG (triangularis), supporting previous findings (Rodd et al., 2005). The effect of phonemic ambiguity specific for words produced increased activation in more posterior regions of LIFG (opercularis). These findings support functional dissociations seen for comparisons of semantic and phonological tasks in the absence of any task-specific neural effects. Therefore, semantic and phonological ambiguity resolution may load separately on anterior and posterior frontal systems.

G49

DO YOU KNOW WHO THAT IS? REAL-WORLD REFERENCE AND COREFERENTIAL PROCESSING Clinton L. Johns[1,2,4], Debra L. Long[1,2,3], Tamara Y. Swaab[1,2]; [1]University of California, Davis, [2]Center for Mind and Brain, [3]University of Central Lancashire, Preston, England, [4]Haskins Laboratories — Establishing coreferential relations between anaphors and their antecedents allows comprehenders to track "who did what to whom" in a discourse. However, anaphors that are used in research rarely refer to actual people, objects or events; characters in experimental stimuli usually possess only minimal semantic detail. This poses a problem, because research has shown that processing difficulty can arise when potential antecedents are semantically similar. For example, sentence comprehension was impaired when two characters were established with the same type of noun phrase, with the greatest difficulty evident when two proper names were used (Gordon, Hendrick, & Johnson, 2001). In order to investigate the influence of real-world information on coreferential processing we manipulated the semantic content of antecedent representations. Event-related potentials were recorded as participants read sentences that contained either a correct or an anomalous pronoun anaphor (e.g., "she" in reference to a male character). Antecedent entities were either fictional (e.g., Bill Jones) or real (e.g., Bill Clinton). Anomalous anaphors elicited a P600 effect. The magnitude of this effect was significantly greater when sentence characters were real. In addition, in congruent conditions we observed a P600-like effect to pronouns with fictional referents relative to pronouns with real referents. Our results suggest that the presence of semantically detailed, high-quality representations in a discourse model facilitates the processing of coherent coreference, and magnifies the processing penalty for referentially failing anaphors.

G50

WORD-FINDING DEFICITS ASSESSED IN VETERANS WITH GULF WAR ILLNESS: AN FMRI STUDY Clifford S. Calley[1], Michael A. Kraut[2], Gail D. Tillman[1], Timothy A. Green[1], Virginia I. Buhl[1], Jack W. Grinnan[1], John Hart[1]; [1]University of Texas, Dallas, [2]Johns Hopkins University — Word-finding problems have been reported among veterans suffering with Gulf War related illnesses. We assessed word-finding in the three Gulf War Illness (GWI) subtypes, each shown to have varying degrees of cognitive complaints, as well as a veteran control group using the Semantic Object Recall Task (SORT) during fMRI acquisition. The SORT requires a subject to decide whether they recall a specific object when presented with two words representing object features (i.e. desert + humps = camel). Whole-brain analyses of individual groups using SPM5 showed more significant signal change in areas involved in word-finding/language processes, namely the pre-supplementary motor area (pre-SMA). A full factorial ANOVA of all four groups also showed significant signal change differences within thalamic and pre-SMA regions of interest. We hypothesize these significant differences were the result of dysfunction associated with this pre-SMA/thalamus circuit.

G51

USE OF N400 TO PARSE SEMANTIC FROM POST-SEMANTIC NAMING FAILURES IN PRIMARY PROGRESSIVE APHASIA Robert Hurley[1], Kenneth Paller[1], Christina Wieneke[1], Sandra Weintraub[1], Cynthia Thompson[1], Kara Federmeier[2], Marsel Mesulam[1]; [1]Northwestern University, [2]University of Illinois — Primary progressive aphasia (PPA), a selective neurodegeneration of the language network, frequently causes object naming impairments. We examined the N400 event-related potential (ERP) to explore interactions between object recognition and word processing in PPA patients and controls. Participants viewed photographs of objects, each followed by a word that was either a match to the object, a semantically related mismatch, or an unrelated mismatch. Patients judged whether word-object pairs matched with high accuracy, but they failed to exhibit the normal N400 category effect (N400c), defined as a larger N400 to unrelated versus related mismatch words. In contrast, the N400 mismatch effect (N400m), defined as a larger N400 to mismatch than match words, was observed in both groups. N400m magnitude was positively correlated with neuropsychological measures of word comprehension but not fluency or grammatical competence, and therefore reflected the semantic component of naming. After ERP testing, patients were asked to name the same set of objects aloud. Trials with objects that could not be named were found to lack an N400m, although the name had been correctly recognized at the matching stage. Even accurate overt naming did not necessarily imply normal semantic processing, as shown by the absent N400c. The N400m was preserved in one patient with post-semantic anomia, who could write the names of objects she could not verbalize. N400 analyses can thus help dissect the multiple cognitive mechanisms that contribute to object naming failures in PPA.

G52

ERP INDICES OF THE CONCEPTUAL MODALITY SWITCH EFFECT: WHAT HAPPENS WHEN LEAVES RUSTLE AFTER CANDLES FLICKER? Jennifer Collins[1], Diane Pecher[2], René Zeelenberg[2], Seana Coulson[1]; [1]University of California, San Diego, [2]Erasmus University, Rotterdam — Responses to stimuli in one perceptual modality (e.g. vision) are slower when preceded by a stimulus from a different modality (e.g. audition) than one from the same modality -- a phenomenon known as the modality switch effect. The conceptual modality switch effect is the finding that people take longer to verify a visual property (e.g. deciding that candles can flicker) after a trial from a different modality (e.g. deciding that leaves can rustle) than after a trial from the same modality. In the current study we investigated the cognitive and neural substrate of the conceptual modality switch effect. We recorded event-related potentials (ERPs) as participants saw words in concept-property pairs and performed a property verification task. We found ERP evidence for the conceptual modality switch effect and observed that auditory and visual conditions elicited different patterns of effects. The earliest differences were observed for visual properties in the 300-500 ms window. We found a greater negativity for visual trials preceded by auditory trials (LEAVES-rustle ? CANDLES-flicker) than when two trials were both from the visual domain (BANDAGES-tan ? CANDLES-flicker). The auditory difference occurred later (550-700 ms) and showed a greater positivity for auditory trials preceded by visual trials (CANDLES-flicker ? LEAVES-rustle) than when both trials were from the auditory domain (HIGH HEELS-click ? LEAVES-rustle). Timing, scalp distribution, and polarity differences of these ERP indices suggest that the processing of visual and auditory properties may be recruiting different underlying perceptual substrates in accordance with theories of embodied cognition.

G53

PARALLEL RECORDING OF EEG AND EYE MOVEMENTS: TESTING THE TIMELINE OF WORD RECOGNITION IN NORMAL READING Olaf Dimigen[1,3], Michael Dambacher[2,3], Alexander Mies[1], Reinhold Kliegl[3], Werner Sommer[1]; [1]Humboldt Universität zu Berlin, [2]Freie Universität Berlin, [3]Universität Potsdam — Brain-electric correlates of sentence reading have mostly been studied in word-by-word presentation (RSVP) in the absence of eye movements (EMs). This paradigm differs in many regards from normal, saccadic reading and allows no direct comparisons between oculomotor behavior and fixation-related brain potentials (FRPs). We summarize results from three experiments (N=96), in which EMs and FRPs were simultaneously recorded during normal, left-to-right reading of 144 sentence pairs. To investigate the timing of word recognition under this condition, predictability and frequency of a target word were orthogonally manipulated. Additionally, in two of the experiments, a gaze-contingent masking of the target word was used to manipulate the amount of parafoveal preview. Signal distortions due to corneoretinal artifacts and differential component overlap were closely controlled. Results are compared with those of three traditional RSVP experiments (N=96) in which the same sentences were presented at slow (SOA 700 ms), medium (490 ms), or reading-like (280 ms) presentation rates. We replicate effects of word predictability and frequency on both fixation durations and FRPs in normal reading. Amplitude and scalp distributions of N400 predictability effects were remarkably similar between saccadic reading and RSVP. However, compared to RSVP with a reading-like speed, predictability effects began considerably earlier in normal reading, indicating that word meaning is accessed within the duration of the word-initial fixation. The two experiments with gaze-contingent masking showed that this early onset was partly explained by a robust parafoveal preview benefit, which was observed in EMs and at the electrophysiological level.

G54

DECISION-MAKING MECHANISMS HELP RESOLVE AMBIGUOUS PRONOUN REFERENCE: FMRI EVIDENCE Murray Grossman[1], Corey McMillan[1], Delani Gunawadena[1], Neville Ryant[1], Robin Clark[1]; [1]University of Pennsylvania — Pronouns are common yet little is known about the neural mechanisms supporting pronoun reference and the resolution of potentially ambiguous reference. We propose a two-component model for resolving ambiguous pronoun reference (e.g., "The client chased the king and he cried"). First, a core language network in perisylvian cortex supports syntactic and semantic resources. Second, a strategic decision-making network supports probabilistic (e.g., Is "client" a male or female) and risk-related (e.g., choosing "client" is risky because "king" must be male) mechanisms. In an fMRI study we presented 16 young adults with 200 sentences pairs including two nouns and one pronoun, and participants identified the pronoun's referent. Sentences included a Directly Determined referent ("The king chased the queen. She cried"), an Indirectly Determined referent ("The king chased the client. She cried") or Underdetermined referents ("The client chased the visitor. She cried" or "The princess chased the queen. She cried"). All conditions revealed left inferior frontal and middle temporal cortex activation, consistent with a core language network. In Underdetermined sentences, when the gender of a gender-neutral noun (e.g., "client") must be evaluated, we observed dorsolateral prefrontal cortex (dlPFC) activation. Previous research has implicated dlPFC as a probabilistic mechanism. In Indirectly Determined sentences, when a gender-neutral noun (e.g., "client") must be selected because the gender-biased noun (e.g. "king") does not match the pronoun's gender, we observed oribitofrontal (OFC) activation. OFC is often implicated in risk-related behavior. These findings are consistent with a two-component model of pronoun processing that incorporates core linguistic and decision-making mechanisms.

G55

CATEGORICAL AND RELATIONAL VERBAL ANALOGY PROCESSING FOLLOWING BRAIN DAMAGE Gwenda L. Schmidt[1,2], Eileen Cardillo[1], Alexander Kranjec[1], Matthew Lehet[1], Anjan Chatterjee[1]; [1]Hope College, Holland, [2]University of Pennsylvania, Philadelphia — The purpose of this study was to explore the neural basis of analogy processing. We examined two broad classes of analogies. The first class were based on mapping category membership of either objects (liquid: water, dance: ballet) or actions (drink: sip, exit: flee). The second class of analogies was based on mapping relations, either thematic (bellhop: luggage, mover: boxes) or locative (bird: cage, tongue: mouth). These analogy tests were given to participants with left hemisphere (LHL, n=17) and right hemisphere lesions (RHL, n=17). Both groups were similarly impaired on categorical analogies (80% and 81% accuracy scores respectively). By contrast, only the LHL participants were impaired on relational analogies (80%). Given that RHL participants were not impaired on relational analogies (91%), we suggest that an intact left hemisphere is needed to extract and map relational structures. The left hemisphere may also be important in mapping functions in general since LHL produced deficits across both kinds of analogy classes. Whole brain voxel-based lesion symptom mapping (VLSM) revealed that impaired ability to make categorical analogies was associated with damage to the right middle temporal and supramarginal gyri. Impaired ability to make relational analogies was associated with damage to the left middle temporal gyrus. Thus we suggest that the left hemisphere is important for abstracting higher-order relations such as those contained in our locative and thematic analogies. Categorical analogies rely on both hemispheres, but with clearer brain-behavior relationships in the right.

G56

DUAL STATUS OF THE ROLE REVERSAL P600: RESTRICTING NON-SURFACE SEMANTIC COMPOSITION Wing Yee Chow[1], Colin Phillips[1]; [1]University of Maryand, College Park — Recent ERP studies (e.g., Kolk et al., 2003; Kim & Osterhout, 2005) have observed a P600 in response to syntactically well-formed sentences in which the thematic roles of verb arguments are "reversed" (e.g., The meal was devouring…), and have taken such observations as evidence for an independent "semantic processing stream" that can compose interpretations that are incompatible with the surface structure of the sentence. Here we highlight the distinction between the environments in which the "role reversal P600" is observed. The current study (n=19) used the subject-object-verb order of the syntactically unambiguous Chinese BA-construction to compare within-subjects the effects of role reversal in the presence and absence of surface animacy violations. Experiment 1 tested whether role reversal affects processing beyond the effect of animacy violation by independently manipulating the presence of an animacy violation and the combinability of the verb-arguments triplets in a 2x2 design using sentences such as: councilor[subj] - proposal[obj] - {(i)reject/ (ii)anger/ (iii)transport/ (iv)poison}. While the non-combinable conditions elicit the N400 response, both animacy-violated conditions (ii) and (iv) show identical P600s, despite the fact that only condition (ii) allows a plausible reversal interpretation. Experiment 2 examined the effect of role reversal in the absence of animacy violation using sentences with animate arguments. As in previous studies, the role-reversed sentences elicited a P600 relative to the non-reversed controls. Our results demonstrate that P600 responses observed in the two contexts are not equally attributable to role reversal, and suggest that surface structures tightly limit comprehenders' access to surface-incompatible interpretations.

G57

FUNCTIONAL CONNECTIVITY OF SEMANTIC REPRESENTATIONS OF VISUAL AND HAPTIC WORDS Laura Baucom[1], Jing Wang[1], Svetlana Shinkareva[1]; [1]University of South Carolina — The sensorimotor theory of conceptual and semantic processing suggests that sensory and motor features become attached to a symbol by correlation (Warrington & Shallice, 1984; Humphreys & Forde, 2001). Based upon the sensorimotor theory, words eliciting visual imagery should activate networks containing areas of the brain responsible for processing visual information, whereas words eliciting haptic sensation should activate networks containing areas responsible for processing somatosensory information. In the current study, we used event-related functional magnetic resonance imaging (fMRI) and a similarity judgment task to identify functional networks containing information regarding words whose meanings were related to either visual or haptic perceptual features. While in the scanner, six participants were presented with word triplets consisting of three highly-related words and were prompted to make a judgment as to which one of two words was most similar to the target word. Stimuli in the visual condition contained words with visual features, such as color and brightness. The haptic condition contained words with haptic features, such as moisture and temperature. Condition-specific functional connectivity between brain areas was defined based on the Pearson correlation coefficient computed between the time-series weighted by the condition-specific hemodynamic response function for each pair of regions. Thresholded connectivity matrices were analyzed to identify clusters of highly interconnected brain regions for the visual and haptic conditions. The results showed differing condition-specific functional connectivity patterns for visual and haptic words. Presumably, the differing functional connectivity patterns were due to differences in semantic representation of visual and haptic words.

G58

FRONTAL THETA AND ALPHA POWER AND COHERENCE CHANGES ARE MODULATED BY SEMANTIC COMPLEXITY IN GO/NOGO TASKS Michael Kraut[1], Matthew Brier[2], Mandy Maguire[2], Thomas Ferree[3], John Hart[2]; [1]Johns Hopkins, [2]University of Texas, Dallas, [3]University of Texas, Southwestern Medical Center — Oscillations as measured by scalp EEG are known to reflect neural processes. Much effort has been put into describing the spatial, temporal, and spectral properties of these oscillations. What is unclear is how two processes that have overlapping distributions interact. We investigated three response inhibition tasks that differed in the level of semantic processing required to perform the task. We designed three tasks, the first requires the subject to make a Go/NoGo decision based on pictures of one car and one dog, the second uses multiple cars and multiple dogs, and the final task requires the higher category of objects and animals. We found that the amplitude of the theta NoGo response was attenuated as a function of complexity while the peak latency was delayed only in the categorization task. Further, frontal alpha desynchronization was strongest for the simplest task and remained close to baseline for the other tasks. Finally, there was significant theta band coherence between the frontal pole and premotor areas for the NoGo conditions across tasks. These data support a frontal response inhibition circuit that is sensitive to changes in task demand reflected by changes in the theta and alpha band.

G59

HOW VISION IS SHAPED BY LANGUAGE COMPREHENSION: TOP-DOWN FEEDBACK BASED ON LOW-SPATIAL FREQUENCIES Gerrit Hirschfeld[1,2], Pienie Zwitserlood[1,2]; [1]University of Münster, [2]Otto Creutzfeldt Center for Cognitive and Behavioral Neuroscience — Next to providing us with an abstract representational system, language is also linked to perception and action. While there is ample behavioral and neuroscientific evidence for the activation of the motor system during comprehension (Pulvermüller, 2005; Glenberg & Kaschak, 2002; Casasanto, 2009), evidence for an influence on visual perception is limited to behavioral studies. Behaviorially, sentential-semantic information speeds up reactions to perceptually-matching compared to mismatching visual objects (Zwaan & Madden, 2005). In this reaction-time study, we spatially filtered the object pictures, to test whether top-down feedback mechanisms based on low spatial-frequency bring about these behavioral effects (Bar, 2004). Frequency information contained in the visual targets was manipulated between participants. We used unfiltered (9o × 9o visual angle in all conditions), high-pass filtered (Adobe PS high-pass filter set to a radius of 0.1 to 0.3 pixels), and low-pass (Adobe PS Gaussian blur filter set to a 6.1 pixel kernel) filtered pictures. Responses were faster to matching compared to mismatching pictures in the unfiltered and low-pass filtered conditions. Critically, no such differences were observed in the high-pass filtered condition. These results extend previous work on low-spatial frequencies in vision (Kveraga, Boshyan, Bar, 2007), supporting a model in which higher cortical areas are important for the interplay between language and vision.

G60

EFFECT OF PROPRANOLOL ON WORD FLUENCY IN AUTISM SPECTRUM DISORDER David Beversdorf[1], Sanjida Saklayen[1,2], Ananth Narayanan[1,2], Katherine Higgins[1], Shawn Christ[1]; [1]University of Missouri, [2]Ohio State University — Autism spectrum disorder (ASD) is a developmental disorder commonly characterized by impairments in language and social interaction, as well as stereotypical behavior. Studies have demonstrated decreased flexibility of access to semantic networks in ASD. Improvement in such network access has been reported in ASD using beta-adrenergic antagonists, including propranolol. This is proposed to be due to noradrenergic effects on the signal-to-noise ratio of cortical neurons. As predicted by this, propranolol improved performance on simple anagrams in ASD patients. In order to determine whether these effects are also observed on semantic network access tasks not involving problem solving, we compared performance on category fluency and letter fluency tasks in ASD and matched controls between propranolol and placebo, using a double-blind, crossover design. Individuals with ASD performed significantly better on category fluency after administration of 40mg propranolol, as compared to placebo. No effect was observed on letter fluency. No difference between drug conditions was demonstrated for either task in the control group. Further work will be needed to confirm this proposed mechanism of action, examine the range of tasks affected, and determine the potential clinical benefit of propranolol in ASD.

G61

IMPLICIT AND EXPLICIT MECHANISMS OF WORD LEARNING IN A NARRATIVE CONTEXT Laura Batterink[1], Helen Neville[1]; [1]University of Oregon — The vast majority of word meanings are learned simply by extracting them from context, rather than by rote memorization or explicit instruction. Although this skill is remarkable, little is known about the brain mechanisms involved. In the present study, ERPs were recorded as participants read stories in which pseudowords were presented multiple times, embedded in consistent, meaningful contexts (referred to as meaning condition, M+) or inconsistent, meaningless contexts (M-). Word learning was then assessed implicitly using a lexical decision task and explicitly through recall and recognition tasks. Overall, M- words elicited a larger N400 than M+ words, suggesting that participants were better able to semantically integrate M+ words than M-words throughout the story. In the lexical decision task, no behavioral or electrophysiological evidence for implicit priming was found for M+ words. This finding suggests that the M+ lexical representations are still only weakly linked within the semantic network and thus cannot be implicitly processed. In contrast, during the explicit recognition task, M+ words showed a robust N400 effect. The N400 effect was dependent upon recognition performance, such that only correctly recognized M+ words elicited an N400. This pattern of results indicates that new words can facilitate semantic integration even after relatively limited exposure, but only if participants have explicitly acquired the meanings of these words. Taken together, the results provide evidence that the explicit semantic system is capable of rapid initial learning, while the implicit semantic system takes time to gradually learn the same or analogous knowledge (Ullman, 2005).

G62

THE EFFECTS OF TASK ON PROCESSING REAL-WORLD, ANIMACY AND SYNTACTICALLY VIOLATED SENTENCES Suiping Wang[1], Tali Ditman[2], Arim Choi[2], Gina Kuperberg[2,3]; [1]South China Normal University, Guangzhou, China, [2]Tufts University, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital — In three experiments, we examined the effects of task on processing verbs and sentence-final nouns in non-violated sentences (.…the boys would eat toast and jam.), animacy violated sentences (...the eggs would eat toast and jam.) and morphosyntactically violated sentences (…the boys would eats toast and jam.). ERPs were recorded as readers self-paced through each sentence word-by-word, and then made acceptability judgments (Exp1), counted the number of violations introduced (Exp2), or answered comprehension questions (Exp3). The pattern of effects on verbs was qualitatively similar across the three tasks: real-world violations evoked an N400 effect, animacy violations evoked a small or no N400 effect but a P600 effect, and syntactic violations evoked no N400 effect and a larger P600 effect. Whereas N400 modulation across conditions was not influenced by task, the magnitude of the P600 effect to the animacy and syntactic violations decreased across the three tasks. Sentence-final nouns following all three types of violations (vs. no violation) evoked an N400 effect between 300-500ms using all three tasks. However, in a later 600-900ms time-window, only sentence-final words following animacy and syntactic violations evoked a sustained negativity effect, which again decreased across the three tasks. These findings suggest that (a) P600 effects can be evoked by both syntactic and animacy violations, regardless of task; (b) task nonetheless interacts with the additional processes reflected by the P600; (c) sustained negativities on sentence-final words following mid-sentence anomalies are likely to reflect an absence of processing rather than prolonged semantic processing.

G63

SUPPORT FOR ANTERIOR TEMPORAL INVOLVEMENT IN SEMANTIC ERROR PRODUCTION IN APHASIA: NEW EVIDENCE FROM VLSM

Grant Walker[1,2], Myrna Schwartz[1], Daniel Kimberg[2], Olufunsho Faseyitan[2], Adelyn Brecher[1], H. Branch Coslett[1,2]; [1]Moss Rehabilitation Research Institute, [2]University of Pennsylvania — [Goal] To replicate and extend a prior lesion-symptom mapping study that localized lexically-based semantic naming errors to anterior temporal lobe (ATL); to rule out potential explanations for failure to implicate Wernicke's area. [Methods] We performed a voxel-based lesion-symptom mapping (VLSM) analysis involving 64 chronic aphasics with left hemisphere stroke. Lesions from recent MRI (n=34) or CT (n=30) scans were segmented manually and registered to a standard 1x1x1mm template. Subjects performed the 175-item Philadelphia Naming Test. In a modification of the published scoring criteria, we expanded the definition of semantic errors to include any response (noun, non-noun, or multi-word description) that was taxonomically or associatively related to the target ("SemPlus"). Scores on non-verbal semantic tests were used to estimate the contribution to SemPlus of pre-lexical, conceptual deficits; and these were factored out by regression ("Resid SemPlus"). In every voxel lesioned in at least 5 patients, a t-test was computed comparing Resid SemPlus between patients with and without lesions in the voxel. The resulting t-map was thresholded to control the False Discovery Rate at q=0.01. [Results] Voxels in mid- to anterior MTG showed an association between Resid SemPlus and lesion status; no association was identified in posterior STG (Wernicke's area). Further analyses ruled out confounding effects of lesion size and naming errors that bear a phonologic rather than semantic relation to the target. [Conclusion] The results replicate and extend our previous findings and strengthen the evidence for a causal relationship between ATL damage and lexically-based semantic errors in naming.

G64

LAGGED WORD PROCESSING IN READING: EVIDENCE FROM SIMULTANEOUS RECORDING OF EEG AND EYE MOVEMENTS

Michael Dambacher[1,2], Olaf Dimigen[2,3], Werner Sommer[3], Reinhold Kliegl[2], Arthur Jacobs[1]; [1]Freie Universität Berlin, [2]Universität Potsdam, [3]Humboldt Universität zu Berlin — Fixation durations during reading are not only determined by characteristics of a currently fixated word n, but increase with the difficulty of a previous word n-1. One controversial explanation for this so-called lag-effect is the assumption that fixation durations are often too short to grant full recognition of difficult words. Accordingly, incomplete word processing spills over to the next fixation and prolongs the recognition of a subsequent stimulus. To delineate the time-course of word processing across several stimuli, word frequency was manipulated on two subsequent targets (words n-1 and n) in an array of unrelated nouns. We co-registered fixation-related potentials and eye movements during left-to-right reading. Additionally, event-related potentials were recorded at a near-normal reading speed in an eye movement-free control condition. Robust influences of past word frequency on inspection times and electrophysiological responses to currently fixated words provided evidence for ongoing processing beyond the duration of fixations. Moreover, interactions of word frequency n-1 and n pointed to interferences between the processing of past and current words during left-to-right reading. The findings support the view of lagged word processing in reading and indicate that mechanisms of oculomotor control and word recognition are partly independent; hence, the data are in line with assumptions of parallel models of oculomotor control.

G65

A FUNNY THING HAPPENED ON THE WAY TO ARTICULATION: N400 ATTENUATION DESPITE BEHAVIORAL INTERFERENCE IN PICTURE NAMING

Trevor Blackford[1], Phillip Holcomb[1], Jonathan Grainger[4], Gina Kuperberg[1,2,3]; [1]Tufts University, [2]MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging, [3]Massachusetts General Hospital, [4]LPC-CNRS, Université de Provence — In a cross-representational masked priming paradigm we measured event-related potentials (ERPs) and naming times to picture targets preceded by masked prime words (SOA: 80 ms) that shared four different types of relationship with their target: (1) Identity related in which the prime was the name of the picture ("cat"-), (2) Phonologically related in which the initial segment of the prime was the same as the name of the picture ("comb"-), (3) Semantically related in which the prime was a co-category exemplar and associated with the name of the picture ("tiger"-), and (4) Unrelated ("book"-). Attenuation of the N400 component to related (vs unrelated) words was taken to reflect the ease of lexico-semantic access while differences in naming times to related (vs unrelated) words reflected the end product of lexical and post-lexical stages of processing. Attenuation of the N400 and shorter naming times were both observed to pictures preceded by identity related (vs. unrelated) lexical primes. No ERP modulation but shorter naming times were observed to pictures preceded by phonologically related (vs. unrelated) lexical primes. An attenuated N400 (electrophysiological priming) but longer naming times (behavioral semantic interference) were observed to pictures preceded by semantically related (vs. unrelated) primes. These dissociations between ERP modulation and naming times suggest (a) that semantic behavioral interference occurs post-lexically, at a later stage of processing than lexico-semantic activation, and (b) that phonological priming also occurs post-lexically, during encoding of the speech response.

G66

SCHIZOTYPAL TRAITS OF HEALTHY PARTICIPANTS ARE RELATED TO SPECIFIC INDEPENDENT COMPONENTS OF THE N400 POTENTIAL

Marie Prevost[1], Vincent Calcagno[1], Louis Renoult[1], Audrey Christina Heppleston[1], J. Bruno Debruille[1]; [1]McGill University — Schizotypal traits have been related to specific variations of the semantic processes indexed by the N400 event-related potential (ERP). These relations seem to depend on participant's paranoid feelings, which can be manipulated by stating that small and harmless currents may be emitted to temporarily change brain function. After this paranoid induction, delusional-like ideation was related to smaller raw N400 amplitudes and the interpersonal factor to reduced N400 effects. Meanwhile, the relation between disorganization and more negative ERPs within the N400 time window vanished. ERP data from two previous studies (with and without induction) using the same semantic categorization task were submitted to independent component analyses (ICAs) separately to see whether or not each schizotypal trait impacts the same IC in the N400 time window. Six ICs in each study were chosen for their distribution, the percentage of variance they accounted for and their overlapping activity in the N400 time window for category exemplars, non-exemplars and the non-exemplars minus exemplars differences. A general linear model tested the relation between schizotypal traits and the activity of each component. In both studies, delusional-like ideation was related to centro-parietal components whereas disorganization and the interpersonal factor were related to frontal components. Paranoid feelings were found to promote the impact of delusional-like ideation on components that differentiated semantic categories whereas it cancelled that of disorganization and the interpersonal factor on such components.

G67

INTERACTION BETWEEN LANGUAGE AND DECISION-MAKING NETWORKS: DIFFUSION TENSOR AND BOLD FMRI EVIDENCE Corey McMillan[1], Jeffrey Duda[1], Delani Gunawardena[1], Robin Clark[1], James Gee[1], Murray Grossman[1]; [1]University of Pennsylvania — Few studies have investigated strategic decision-making in language. We hypothesize a two-component model for minimizing semantic ambiguity (e.g., saying "animal cage" instead of "pen"). A core semantic network in anterior temporal (aT) and superior temporal (STS) regions supports word meaning. A decision-making network includes: a probability mechanism in dorsolateral prefrontal cortex (dlPFC) to calculate a homophone's likely meaning (Does "pen" refer to a writing instrument or animal cage?); a value mechanism in orbitofrontal cortex (OFC) to calculate risk associated with an interpretation (Will "pen" be interpreted correctly?); and a mechanism in inferior parietal cortex (IPC) that integrates these components (Expected Utility). In an fMRI study, 18 young adults performed a sentence-completion task by choosing a homophone ("pen") or a related alternative ("cage"). Each item included a sentence biasing the homophone meaning (dominant: "Tony has ink"; subordinate: "Tony has pigs"; neutral: "Tony had a job") followed by a completion sentence ("He needed a __.") and decision (pen or cage). OFC, dlPFC, and IPC were activated in the subordinate context to support decision-making when a homophone is likely to be misinterpreted; aT and STS were recruited to support semantic resources required for word meaning. A correlational network analysis revealed coactivation of all regions. Diffusion tensor imaging (DTI) from a subset of participants (n=10) related the arcuate fasciculus to this BOLD activation, and related the rate of minimizing ambiguity to the inferior longitudinal fasciculus. These findings provide functional and structural evidence for the interaction between semantic and decision-making networks during language processing.

G68

HEMISPHERIC DIFFERENCES IN INTERPRETING CONCEPTUAL MAPPINGS: AN EVENT-RELATED POTENTIAL STUDY Tristan S. Davenport[1], Seana Coulson[1]; [1]University of California, San Diego — Two experiments investigated the neural processes underlying the comprehension of literal language that differed in predictability and in semantic complexity. EEG was recorded as healthy adults read three classes of linguistic stimuli: high-cloze literal (The last thing he did when leaving his house was to lock the front door.), low-cloze literal (He tried to sneak into the warehouse but couldn't find the door.), and low-cloze literal mapping (LM)(For a good action hero, a window can easily be a door.). Sentences were presented visually in the center of a computer monitor, at a rate of one word every 500ms. ERPs were timelocked to the onset of sentence-final words. Target words appeared centrally (Experiment 1) and in either the right visual field (rvf) or the left (lvf) (Experiment 2), to test for hemispheric asymmetries in complex semantic processing. Following central presentation, both low-cloze conditions elicited larger N400 than did high-cloze literal. Low-cloze LM sentences also elicited larger P600 than low-cloze literals, suggesting the demands of conceptual integration are evident 600-900ms post-onset. Following lvf presentation, low-cloze LM stimuli elicited larger N400 and P600 than low-cloze literals; both effects were more prominent over right hemisphere electrodes. Following rvf presentation, low-cloze literal stimuli elicited larger N400 than low-cloze LM stimuli over LH sites, with no difference in the P600. These data suggest a left hemisphere advantage in processing literal mappings for the lexical integration processes indexed by the N400 and an important right hemisphere contribution in the later stages of processing indexed by the P600.

G69

THE NEURAL CAREER OF METAPHOR: AN FMRI STUDY Eileen Cardillo[1], Alex Kranjec[1], Gwenda Schmidt[2], Anjan Chatterjee[1]; [1]University of Pennsylvania, [2]Hope College — Novel metaphors regularly infiltrate the collective vocabulary of a speaker group. Bowdle & Genter (2005) provide behavioral evidence that this shift from novel to conventional usage is accompanied by a shift in how metaphors are understood, a process they call the "career of metaphor." One implication of such a change is that it's paralleled by a shift in neural recruitment. We tested this proposal in an fMRI study by parametrically varying participant familiarity with an initially novel set of metaphors. Before scanning, subjects made either two or five judgments about a subset of metaphors, thereby operationalizing their familiarity with them. During scanning, subjects simply read metaphors and answered periodic comprehension questions. Items were either those metaphors they had already judged, or ones they had not previously encountered. Preliminary analyses with 13 subjects confirm neural sensitivity to familiarity: compared to items previously seen five times, metaphors encountered for the first time activated left prefrontal cortex. In addition to addressing changes in metaphor processing with experience, this study also considered potential differences in neural substrates for different types of metaphor. To do so, half of items were noun-based, nominal metaphors (His smile was a charming dodge) and half were verb-based, predicate metaphors (The pie murmured to the dieter). Consistent with proposals that different metaphor types entail different cognitive processes, lateralization differences emerged when comparing nominal and predicate metaphors, collapsed across levels of familiarization. Together, these results confirm the importance of both metaphor type and familiarity in determining how it is processed.

G70

N400 COMPONENT IN LEARNING DISABLED CHILDREN Thalia Fernandez[1], Paula López-Alanís[2], Gloria Avecilla[1], Raquel Ocejo[3], María del Carmen Rodríguez[4], Belén Prieto[5], Melissa Calderón[1]; [1]Instituto de Neurobiología, UNAM, [2]Universidad Latina de América, [3]Facultad de Psicología, UNAM, [4]Universidad Autónoma de Queretaro, [5]FES-Iztacala, UNAM — Few investigations had explored N400 component of the Evoked Related Potentials (ERPs) in Learning Disabled children, and their results are not consistent. LD is diagnosed when the child has values substantially below that expected for his/her age, scholar grade, and IQ in reading, writing, and arithmetic standardized tests. Two groups were studied: 15 LD children (LDC), and 12 normal children (NC). Referential EEG recordings were obtained in the 19 leads performing a semantic task: two words were displayed in a monitor and he/she had to answer if they were related (cat-dog) or not related (pen-salt) pressing one of the two mouse buttons. Mean ERPs were calculated only from correct answers. In individual visual analysis, almost all NC showed two components related with no-related words; however, in few LDC was possible to determine these waves. This was confirmed in the Grand Average Potentials: NC exhibited a N400 component at 535-570 ms localized in left parietal and midline leads; it was preceded by an early right frontal component at 315-390 ms. LDC children showed significant differences between conditions at 665-685 ms only in right frontotemporal lead. These results suggest: a) the paradigm used is useful to evoke a N400 component in normal children, and b) LD children do not evoke a N400 component to unrelated pairs of words with the topography and latency observed in NC, which suggests that LD children had a neurophysiological deficit that may explain their learning difficulties. * Supported by grants IN204103 from PAPIIT, and 69145 from CONACyT.

G71

NEW BUZZWORDS: EARLY CORTICAL RESPONSES TO PSEUDO WORDS AFTER AFFECTIVE CONDITIONING Magdalene Ortmann[1], Christian Dobel[1], Johanna Kissler[2], Markus Junghöfer[1]; [1]University of Münster, Germany, [2]University of Konstanz, Germany — Emotional compared to neutral words receive preferential processing at visual sensory cortex regions starting already at 200ms (Kissler et al., 2007). Convergent effects have been shown for various kinds of emotional visual stimuli and are assumed to reflect motivated attention leading to top-down re-entrant modulation of sensory processing. Using associative learning with a multitude of different faces we have recently been able to show that aversively conditioned faces evoke motivated attention and convergent correlates of amplified sensory processing beginning around 130ms and even in absence of contingency awareness (Putsche et al., under rev.). Additionally we found preferential sensory CS+ processing already before 100ms supporting two-pathway models as for instance suggested by LeDoux (2000; "low road – high road") or Bullier (2001, "fast brain"). Here we aimed to investigate whether this rapid and implicit emotional learning occurs also for words and whether magnetoencephalographic correlates can support the idea that rapid "low road" or 'fast brain" processing is a general phenomenon and not limited to biological stimuli. 52 pseudo words were paired three times each with one of 52 pictures depicting aversive or neutral objects (shark, bottle, etc.). Comparison of event related fields to pseudo word presentation before and after learning confirmed our hypotheses, showing enhanced sensory activity for aversively conditioned pseudo-words after learning at an early ("low road") and a mid-latency ("high road") interval of information processing. These results were supported by behavioral tests showing significant effects of emotional content even in the absence of contingency awareness.

G72

FLEXIBLE IMPLEMENTATION OF HEMISPHERIC PROCESSING BIASES DURING SENTENCE COMPREHENSION Edward W. Wlotko[1], Kara D. Federmeier[1]; [1]University of Illinois — During sentence comprehension, the left hemisphere (LH) engages in predictive processing whereas the right hemisphere (RH) is driven by integrative comprehension strategies. Event-related potential (ERP) studies investigated hemispheric contributions to comprehension by presenting words in the left or right half of the visual field (LVF or RVF). RVF/LH N400s were facilitated more for weakly expected sentence endings compared to the LVF/RH pattern, consistent with the idea that the LH engages in predictive processing even when context is only moderately predictive. The P2 was enhanced for words presented to the RVF/LH when sentence context was strongly predictive, whereas the LVF/RH P2 was not affected by sentential context, suggesting that LH predictive processing can extend to the perceptual level. We followed up on these results using strongly and weakly constraining (predictive) contexts that were completed by plausible endings that could be expected, unexpected, or unexpected but related to the most expected completion. Consistent with data from central presentation, predictive processing was less apparent when related endings were included in the design. There were no asymmetric P2 effects, and the N400 facilitation for weakly expected endings was diminished. Further, while neither hemisphere showed much N400 differentiation between the unexpected and related endings, later effects of relatedness were exaggerated particularly for LVF/RH endings, consistent with the claims that the two hemispheres may differ in controlled processing. These results suggest that processing biases are flexible, as different experimental contexts lead to recruitment of the hemispheric biases to differing degrees.

G73

MODULATION OF EARLY ALPHA AND BETA EEG POWER REFLECTS CLASS AND CONTEXT DURING VISUAL WORD PROCESSING Monika S. Mellem[1,2], Marcel C. M. Bastiaansen[3,4], Lea K. Pilgrim[5], Andrei V. Medvedev[2], Rhonda B. Friedman[2]; [1]Interdisciplinary Program in Neuroscience, Georgetown University, [2]Georgetown University, Neurology, [3]Donders Institute for Brain, Cognition, and Behaviour, Center for Cognitive Neuroimaging, Nijmengen, The Netherlands, [4]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, [5]University of Stirling, Scotland — Word class and context have been shown to affect early lexical processing; however, the neurophysiological mechanisms causing this effect are not well understood. This study investigated how word class and context affect local neuronal synchronization by studying event-related changes in EEG power. We recorded 64-channel EEG (Neuroscan) while ten subjects silently read 840 words which appeared on a computer monitor for 400 msec (ISI = 800 msec) in either a sentence or list context. Artifact-free EEG epochs sampled at 500 Hz were analyzed using the Fieldtrip software. Time-frequency representations of EEG power were calculated in a wide range of frequencies (2-100 Hz) and analyzed for open class (contains semantic information, i.e., nouns, verbs, adjectives) and closed class (contains minimal semantic information, i.e., pronouns, prepositions, conjunctions) words in a sentence or in a list context. Nonparametric statistical analysis showed that relative to the sentence context, open class words in the list context exhibited significantly greater power increases ($p<0.03$) in the alpha (8-12 Hz) and lower beta (13-20 Hz) frequency bands. These differences were observed at an early stage of lexical processing (50-250 msec) over bilateral occipito-temporal and frontal regions. There was no significant difference for closed class words across these contexts ($p=0.16$). These results suggest that early word context effects are restricted to open class words. Increased neuronal synchronization in the alpha and beta frequency bands may reflect dynamic anterior-posterior network coupling needed when reading open class words during less supportive contexts.

G74

THE EFFECTS OF SEMANTIC CONGRUITY FOUND FOR HIGHLY REPEATED WORDS ARE PRESENT IN EXPLICIT BUT NOT IN IMPLICIT SEMANTIC DESIGNS Louis Renoult[1,2], Xiaoxiao Wang[2], Jennifer Mortimer[1], J. Bruno Debruille[1,2]; [1]Douglas Mental Health University Institute, Montréal, Québec, Canada, [2]McGill University, Montréal, Québec, Canada — A number of studies have shown that repetition can disrupt the processing of meaning, resulting in a reduction or a suppression of semantic effects. However, we have recently found preserved effects of semantic congruity on reaction times (RTs) and N400 event-related potentials (ERPs) in primed semantic categorization tasks with highly repeated target words. The preservation of semantic processing with repetition in these studies could be due to the use of long SOAs (2000ms), of relatively high ratios of related words (50%), or of explicit semantic instructions. The present study investigated these possibilities. We contrasted a short (250ms) and a long (1000ms) SOA in two different experiments using a lower proportion of related words (30%). One group of participants (N=22) performed a lexical decision task (LDT) and a second group (N=19) performed an explicit matching task with the same words (except for pseudowords) and the same task parameters. In both tasks, word stimuli were only two primes and two target words repeated throughout the experiment. Results showed that the effect of semantic congruity on RTs and N400 was absent for both the short and the long SOA in the LDT but was widely significant in the explicit task. The maintenance of the processing of meaning with repetition thus does not seem to be directly related to variations in SOA or in the proportion of related words. Task instruction seems critical to preserve semantic processing with repeated presentations, which suggests that explicit attention to semantics prevents semantic satiation.

G75

INDUCTION OF CATEGORY-SPECIFIC VS. GENERAL SEMANTIC IMPAIRMENTS USING RTMS Gorana Pobric[1], Elizabeth Jefferies[2], Matthew Lambon Ralph[1]; [1]Neuroscience and Aphasia Research Unit, [2]York Neuroimaging Centre — How the brain encodes the meaning of words and concepts has puzzled philosophers, cognitive scientists and neuroscientists alike. Some contemporary computational models suggest that concepts reflect a hub-and-spoke combination of information – modality-specific association areas support sensory, verbal and motor sources (the spokes) whilst anterior temporal lobes (ATL) act as an amodal hub. We used off-line rTMS to delineate between three different hypotheses: (a) distributed-only – concepts reflect the conjoint action of modality-specific areas alone; (b) hub-only – in which concepts are formed within (ATL) and modality-specific regions only provide sensorimotor input/output gateways rather than making a necessary contribution to conceptualisation; (c) hub-and-spoke – in which modality-specific regions provide the basic sensory, motor and verbal ingredients whilst the ATL hub supports an additional amodal representation which codes the pan-modal information. We delineated between these competing theories by investigating category-specific impairments. Specifically, we compared the effect of stimulating the left ATL, inferior parietal lobule (IPL) and occipital pole in normal participants prior to naming pictures and numbers. If the ATL is involved in semantic memory, as proposed, then rTMS should generate a category-general effect. If the IPL spoke is implicated then stimulation should impact on semantic performance but only for concepts that rely on praxis information – i.e., manipulable manmade objects. We demonstrate novel and striking evidence in favour of hub-and-spoke hypothesis by applying rTMS to normal participants: ATL stimulation generates a category-general impairment whilst IPL stimulation induces a category-specific deficit for manmade objects, reflecting the coding of praxis in this neural region.

G76

TURNING DOWN THE VOLUME ON SEMANTICS: IMPAIRED KNOWLEDGE OF SOUND-WORDS IN LOGOPENIC PROGRESSIVE APHASIA Michael F. Bonner[1], Murray Grossman[1]; [1]University of Pennsylvania — OBJECTIVE: fMRI studies of semantic memory have indicated that word meanings for concrete objects rely on feature representations in perceptual-motor association cortices. We tested this theory in logopenic progressive aphasia (LPA), a disorder linked to superior temporal cortical atrophy affecting auditory association cortex. We hypothesized an impairment in LPA for words with strongly associated auditory features. METHODS: An auditory lexical decision task was employed using words with strongly associated features (determined in a norming study) in three modalities: Auditory, Motor and Visual. LPA (n=6) were compared with healthy, age-matched controls (HC; n=22) and a dementia-control group (DC; n=9) comprising patients with semantic dementia and corticobasal syndrome. RESULTS: LPA had significantly lower accuracy than HC for Auditory words (LPA: M=88.8%, SD=10.7; HC: M=99.1%, SD=1.6; p<.05), while these groups did not differ for Motor (LPA: M=94.6%, SD=9.8; HC: M=98.9%, SD=1.8) and Visual words (LPA: M=92.5%, SD=11.7; HC: M=98.3%, SD=3.7). Within LPA, Auditory words were impaired relative to Motor (p<.05) and Visual words (p=.06); Motor words did not differ from Visual words, emphasizing the selective deficit for Auditory words in LPA. DC performed poorly on all word categories relative to HC (Auditory: M=90.3%, SD=9.5, p<.001; Motor: M=90.0%, SD=11.9, p=.001; Visual: M=93.3%, SD=7.4, p<.05). Within DC, word categories did not differ. Quantitative MRI studies of LPA verify auditory association cortex thinning. CONCLUSIONS: These findings are consistent with the "sensory-motor" theory of semantics suggesting that word meanings rely on feature representations in modality-specific association cortices, and this patient work provides converging evidence for fMRI studies.

G77

RIGHT HEMISPHERE ROLE IN NEW WORD ACQUISITION AND POSSIBLE INDIVIDUAL DIFFERENCES Travellia Tjokro[1], Christine Chiarello[1]; [1]University of California, Riverside — The current project investigated the role of the right hemisphere in the process of acquiring new words and meanings, and whether this is modulated by an individual's reading skill as measured by Nelson-Denny Reading Test. Beeman proposed that the right hemisphere has a coarse coding style, and is better able to integrate distant semantic relations in contrast to more fine semantic coding within the left hemisphere (Beeman & Chiarello, 1998), A coarse coding style may help in learning the meanings of new words (Ince & Christman, 2002). In addition, a right hemisphere advantage in learning new words may be influenced by reading skill (see Perfetti, Wlotko, & Hart, 2005). In the current 2-day study, new words and meanings were presented either 2 or 8 times, thereby varying the number of semantic learning contexts. Forced choice recognition tested learning of new words, followed by the critical divided visual field semantic relatedness judgment test. It was predicted that skilled readers would utilize the most appropriate hemispheric strategy, resulting in a left hemisphere advantage for more repeated words, and right hemisphere advantage for less repeated words. Less-skilled readers were predicted to have less hemispheric asymmetry in the more repeated condition. The data suggest a right hemisphere advantage for the less repeated condition, but only for less-skilled readers. Richer semantic context significantly improved performance for skilled, but not less skilled, readers. The data suggest that less-skilled readers utilized more of the coarse coding style of the right hemisphere in learning new words.

G78

BEHAVIOURAL AND ERP EVIDENCE FOR EARLY RETRIEVAL OF LEXICO-SEMANTIC INFORMATION IN VISUAL WORD RECOGNITION Olaf Hauk[1]; [1]MRC Cognition and Brain Sciences Unit — Timing information from electrophysiological data is increasingly becoming relevant for models of visual word recognition. It is also important when specific stages of the word recognition process are supposed to be compared between participant and patient groups. In this study, we were attempting to separate stimulus- from response-related ERP effects, and provide a lower limit for the earliest latencies of lexical and semantic information retrieval. Subjects performed 3 different types of Go/NoGo tasks: lexical decision (LD), semantic decision (SD), and orthographic decision (OD). Behavioural as well as 64-channel ERP data were recorded. Statistical analysis of ERP data was performed using SensorSPMs in SPM5. Assignment of stimulus category (e.g. words or pseudowords in LD) to Go or NoGo trials was counterbalanced across subjects. This allowed separating response-related and stimulus-related effects. Reaction times around 350 ms after word onset already reliably distinguished stimulus categories in LD and SD, and around 300 ms in OD. In the ERP data, a reliable difference between Go and NoGo conditions was observed around 200 ms in all three tasks. Our results demonstrate that brain responses around 200 ms already reflect target detection or response preparation. Earliest retrieval of lexical and semantic information must therefore have occurred before 200 ms.

G79

NOVEL EVIDENCE FOR A CAUDAL-ROSTRAL GRADIENT OF CONVERGENCE IN THE HUMAN TEMPORAL LOBE: A PROBABILISTIC MR TRACTOGRAPHY STUDY Richard J. Binney[1], Karl V. Embleton[1], Geoffrey J. M. Parker[1], Matthew A. Lambon Ralph[1]; [1]University of Manchester, UK — At the turn of the decade, Mesulam proposed that cognition, and indeed consciousness, arises from a gradual convergence and integration of sensory information. Such convergence occurs as information proceeds from primary sensory cortex through a set of unimodal association regions onto transmodal association cortices in which information from different sensory modalities come together. The manner in which this convergence occurs in the human temporal lobe is based primarily on tracer-based connectivity studies of the non-human primate brain. Here we present the first attempt to characterise connectivity within the human temporal lobe, in vivo, using diffusion-weighted imaging tractography. The results suggest that while modality-specific processing predominates over inferior-medial and superior structures, intermediary areas exists along the entire length of the temporal lobe. In addition, there are increasing degrees of cross-modal processing as information flows in the caudal-to-rostral direction until the temporal pole, at which the information encoded is principally amodal. Our findings are in agreement with those of previous primate connectivity studies, but also extend our knowledge of the way in which the human brain has evolved to incorporate multiple interactive stages of integrative processing to facilitate higher cognitive function and representation. Furthermore, this convergence peaks at the temporal pole providing further evidence that this region is key in the process of conceptualisation.

G80

THE FUNCTIONALLY HIERARCHICAL ORGANIZATION OF THE SUPERIOR TEMPORAL SULCUS IN SPEECH PERCEPTION Dale Maddox[1], Jon Venezia[1], Greg Hickok[1]; [1]University of California, Irvine — The superior temporal sulcus (STS) plays an important role in the perception of intelligible speech. Previous studies of speech intelligibility have highlighted both anterior and posterior portions of the STS (aSTS and pSTS, respectively). The functional distinction between aSTS and pSTS remains speculative though. The posterior portions of the sulcus are thought to support phonemic perception and the categorization of complex sounds, whereas the anterior portions are responsive to sentence-level stimuli—suggesting a role in semantic, syntactic, or prosodic processing. Here we use a 3T fMRI block design to investigate the relative contribution of semantic and syntactic information (in the absence of prosodic regularity) in driving aSTS response. The study also explores the neuronal response to intelligible speech by contrasting it with spectrally inverted (unintelligible) speech. The results indicate significant increases in BOLD response throughout the STS and adjacent cortical regions (STG/MTG) for the intelligible > unintelligible contrast. A region along the ventral bank of aSTS shows increased activation for sentences with list-like prosody when compared to randomly ordered word lists. Signal changes in this region are positively coupled with activity in the posterior superior temporal plane (pSTS/STG). These findings are interpreted as evidence that the posterior superior temporal regions are involved in the perception of intelligible speech, remaining active as more semantic and syntactic integration is required by the cognitive system, and a particular portion of the ventral aSTS/ATL appears to be driven by combinatorial or integrative semantic and syntactic operations in the absence of robust prosodic cues.

G81

ASSOCIATION AND DISSOCIATION OF SEMANTIC AND LEXICAL KNOWLEDGE OF ENGLISH WORDS: EVIDENCE FROM A NORMAL POPULATION Lang Chen[1], Timothy T. Rogers[1]; [1]University of Wisconsin, Madison — Previous neuropsychological studies have shown that patients with serious semantic impairment can occasionally achieve normal accuracy on lexical tasks such as reading and recognizing regular and irregular words. The reverse dissociation has also been observed, and this double dissociation between semantic and lexical knowledge is cited as strong evidence for the functional independence of semantic and lexical representations of words. In seeming contradiction to this conclusion, studies of semantic dementia that produces the purest form of semantic impairment reveal a strong association between lexical and semantic impairment. This work favors a single-system model where both kinds of knowledge are represented in a distributed and interactive manner. The present study aims to reconcile the apparent contradiction in patient studies by examining, in healthy participants, the effects of semantic interference on a lexical task, namely visual lexical decision (vLD). Two experiments were conducted to test (i) whether semantic processing interferes with visual word recognition, and (ii) how semantic interference varies with individual differences in orthographic knowledge, reading experience, and cognitive control. The results showed (1) substantial semantic interference on vLD in the majority of participants, but (2) no interference in a small number of individuals with superior cognitive control ability and/or orthographic knowledge. Thus in most people, word recognition appears to depend upon semantic input, but for a small proportion with especially well-developed orthographic representations, such input may not be necessary. This view is consistent with the single-system framework assuming that individuals vary in the nature and extent of their linguistic experience.

G82

SENTENCE COMPREHENSION IN AGRAMMATIC APHASIA: EYE-TRACKING EVIDENCE FOR A LEXICAL INTEGRATION DEFICIT Aaron M. Meyer[1], Jungwon J. Choy[1], Cynthia K. Thompson[1]; [1]Northwestern University — Swinney et al. (1989) have argued that agrammatic aphasics fail to activate less frequent (subordinate) meanings of ambiguous words (e.g., "bank") or activate these meanings slowly. In contrast, Hagoort's (1993) lexical integration deficit hypothesis argues that individuals with aphasia are able to access lexical-semantic information, including subordinate meanings, but have difficulty integrating this information with context. We tested these hypotheses in a comprehensive manner by examining subordinate- and dominant-meaning selection in both biasing and neutral sentence contexts (e.g., Dominant-Biased: "The man had a good job while working at the bank for a while"; Subordinate-Biased: "The man had a nice nap while relaxing on the bank for a while"; Neutral: "The man had a big smile while staring at the bank for a while"). On critical trials, aphasic participants and age-matched control participants viewed an array of clip-art pictures that contained the dominant and subordinate referents and two unrelated distractors. Looks to each type of picture were tracked over time while participants listened to the sentence stimuli. Fixation proportions indicated that the meaning that was consistent with context (subordinate or dominant) was selected, and the dominant meaning was selected in a neutral context. However, agrammatic aphasics' fixations of the correct picture were delayed in the dominant-biased context, compared to age-matched control participants. These results indicate that both dominant and subordinate word meanings are activated in agrammatic aphasia, but the integration of lexical-semantic information with context is delayed under some conditions. These findings support the lexical integration deficit hypothesis.

G83

BROCA'S AREA IS ENGAGED DURING CONDITIONAL REASONING IN NATURAL SENTENCES Jörg Bahlmann[1], Jutta Mueller[1], Michiru Makuuchi[1], Angela Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — During language processing the brain does a remarkably good job in the interpretation of the content of a particular sentence. The content of a sentence can be either affirmative or negative. Sentential negation is a linguistic feature that triggers the truth value of the content. Behavioral studies that investigated sentential negation showed higher processing costs for negations in comparison to affirmations. Only few fMRI that manipulated the truth value of sentences experiments have been accomplished so far. None of these studies reported activation in the classical perisylvian network including the left inferior frontal and the superior temporal cortex. To our knowledge, double negations have not been tested yet in an fMRI setting. In the present study we applied double negation sentences. Double negations have frequently been examined in the research field of logical or propositional reasoning. Usually, reaction times increase during the processing of double negations (If not p, then not q) compared to single negations (If p, then not q) or to no negation (If p, then q). The resolution of a double negations is considered to be associated with the difficulty to generate a conclusion. As a result, we found a network comprising of the left pars opercularis (BA 44), and the bilateral inferior parietal gyrus (BA 40) to be activated during the processing of double negations as compared to affirmations. The study shows that a typically language-related area (left BA 44) interplays with areas related to cognitive demands and logical/conditional reasoning, in order to process double negations.

G85

CONFLICT BETWEEN SEMANTIC AND SYNTACTIC CUES DURING SENTENCE COMPREHENSION: AN FMRI STUDY Malathi Thothathiri[1,2], Albert Kim[3], John Trueswell[1], Sharon Thompson-Schill[1]; [1]University of Pennsylvania, [2]Moss Rehabilitation Research Institute, [3]University of Colorado — A number of fMRI studies have investigated the role of left inferior frontal gyrus (LIFG) in sentence comprehension. These studies typically manipulate syntactic factors such as complexity and distance between different constituents. The results have been used to argue that LIFG specifically underlies the representations or resources that support syntactic processing (e.g., working memory, syntactic movement). Here, we investigated the role of LIFG in integrating semantic and syntactic information. Participants judged the acceptability of visually presented sentences. We contrasted three sentence types: 1. active sentences that contained conflict between semantic and syntactic cues (The check was cashing the accountant); 2. correct passive sentences that contained no such conflict (The final grades were posted by the teacher); and 3. syntactically anomalous passive sentences that also contained no conflict (The building plan was modify by the architect). Two regions of interest (ROIs: left frontal and left temporal cortex) were extracted from a group analysis of all sentences versus a baseline false font condition. Active sentences with conflict showed more activation in both ROIs than correct and anomalous passives that contained no conflict. These results provide insight into the interaction between semantic and syntactic factors during sentence processing. In particular, they argue against a solely syntax-focused role for LIFG because passive sentences, which are more syntactically complex, showed *less* LIFG activation than simpler active sentences. Instead, the results suggest that LIFG involvement is sensitive to the conflict between semantic and syntactic cues.

G86

REVERSING CAUSAL COHERENCE THROUGH LINGUISTIC CUES: EVIDENCE FROM EVENT-RELATED POTENTIALS Ming Xiang[1], Abigail Swain[2], Gina Kuperberg[2]; [1]University of Victoria, [2]Tufts University — We used ERPs to examine neural activities associated with establishing causal coherence across sentences. 180 sets of three-sentence scenarios were constructed, each with four conditions. A critical word in the final sentence (“closed”) was either causally coherent or incoherent with its context (1a&1b). The addition of the scalar term “even so”, in front of the final sentence, reversed coherence (1d&1c). 1a/c "Carol listened to the radio. The storm last night had dumped several feet of snow. (Even so,)The schools were closed that day." 1b/d "Carol listened to the radio. The storm last night had only left a dusting of snow. (Even so,)The schools were closed that day." In Experiment 1, participants (n=28) explicitly rated causal coherence on a 1-5 scale. Incoherent (1b) (vs. coherent (1a)) critical words evoked an N400 followed by a P600 effect. The addition of “even so” (1d&1c) led to both a larger N400 and P600 effect. In Experiment 2, participants (n=20) read the same sentences but simply answered comprehension questions on 25% of trials. Incoherent (versus coherent) critical words evoked only a small P600 effect. The addition of “even so” led to both an N400 and a P600 effect. We conclude that, in medium-constraint contexts, people can apply causal relations across clauses to immediately process the semantics of upcoming words, particularly under task conditions that encourage explicit coherence linking or with the help of explicit linguistic cues. Indeed, such cues can be used to effectively reverse causal coherence across clauses during online neural processing.

G87

LANGUAGE-SPECIFIC CONTEXTUAL MODULATION OF BILINGUAL SEMANTIC PROCESSING Lawrence Benjamin Lewis[1]; [1]Loyola University, New Orleans — Prior research has demonstrated that bilinguals engage a frontal-parietal-subcortical network that powers the necessary language shifting and inhibition cognitive mechanisms necessary to control the use of their two languages (e.g., Abutalebi et al., 2008). The present study employed a bilingual Stroop paradigm to assess the role of language context on linguistic inhibition. Adult participants were asked to name aloud the ink color of printed strings of nonlinguistic symbols to provide a language context. Subsequently, they read the color words of one language using the color terms of the other (e.g., responding "rojo" to the word "blue" printed in red ink). There were four types of trials separated by distractor tasks. Trial 1 comprised naming ink colors on the context sheet in English, then responding to Spanish color words in English. Trial 2 had an English context, with English color words named in Spanish. Trial 3 provided a Spanish context, followed by naming Spanish color words in English, while the context for Trial 4 was Spanish, with English color words named using Spanish color terms. Results revealed that participants' color naming times were significantly faster when the context language matched the response language ($M = 5.73$ sec) than when it did not ($M = 15.85$ sec), $F(1, 252) = 31.40$, $p < 0.001$. Priming the response language through context strongly facilitated inhibition of the written language in the task. These findings represent a step toward quantifying the role of context on the inhibitory mechanisms involved in bilingual language processing.

G88

LOCATING THE N400 IN TIME AND SPACE Nuria AbdulSabur[1,2], Ellen Lau[3], Diogo Almeida[4], Chunmao Wang[1], David Poeppel[5], Allen R. Braun[1]; [1]NIDCD, National Institutes of Health, [2]University of Maryland, [3]Massachusetts General Hospital, [4]University of California, Irvine, [5]New York University — The underlying neural mechanisms of the N400, a negative event-related potential (ERP) deflection that onsets around 200 ms, peaks around 400 ms and subsides around 600 ms after semantic violations in sentences, are still under debate. The N400 is characteristically temporally broad and spatially inexact. Magnetoencephalography (MEG) is an appropriate tool in that it allows for the superior localization of sources in both time and space and is capable of decomposing different sources contributing to the N400 response. Although both MEG and fMRI have previously been employed to localize the N400, this study utilizes the synthetic aperture magnetometry (SAM) beamforming method, which results in a dataset that combines the temporal resolution of MEG and spatial resolution of MRI. In the current study, healthy volunteers underwent concurrent electroencephalograph (EEG) and MEG recordings while completing a traditional N400 paradigm in which sentence-final words either upheld or violated the semantic context. A structural MRI was completed afterward and used as an anatomical template for MEG data. Results from the time period of the N400 (as defined by EEG recordings) show activation in the frontal and temporal lobes that begins with left-dominated activation, shifts to the right, and back to the left hemisphere, indicating the involvement of a bilateral network of brain regions. These findings demonstrate the N400 arises from a dynamic series of neuronal events in both hemispheres.

G89

AN ERP STUDY OF CONCRETENESS EFFECTS IN IMAGERY AND ASSOCIATE GENERATION: EVIDENCE FOR THE DUAL CODING THEORY Marc Joanisse[1], Allan Paivio[1], Ken McRae[1], Suzanne Welcome[1]; [1]The University of Western Ontario — Dual coding theory (Paivio, 1971) suggests that concrete words activate both verbal and image-based codes, while abstract words primarily activate verbal codes, resulting in processing advantages for concrete words. This theory predicts that partially distinct neural substrates might support the processing of abstract and concrete words. Previous studies, using primarily lexical decision tasks, have shown that word concreteness modulates ERP components, including the N400 and a later (N700) component. Because mental image generation may take several seconds, we chose to examine ERPs during tasks that allow time for mental image generation to occur. In separate blocks, participants were asked to form mental images or generate verbal associates to abstract and concrete words. In reaction time data, concreteness effects were significant under mental imagery instructions, but not associate instructions. We saw no reliable difference in N400 amplitude between abstract and concrete words during either task. Later in processing, abstract words in the imagery condition elicited a more negative waveform than concrete words, while no such difference was observed for the associate condition. Time-frequency analyses revealed that abstract words elicited more power in the 8-20 Hz range during mental image generation in a time window centered around 800 msec before responses. These results by demonstrate that concrete and abstract words differ in both amplitude and time frequency analyses, as predicted by dual coding theory. While generating verbal associates results in relatively similar patterns of results for abstract and concrete words, differences emerged when mental imagery of abstract words was required.

Perception & Action: Development & Aging

G90

SLEEP DEPRIVATION AND AGING PRODUCE DISSIMILAR DISTORTIONS IN LONG-TERM MEMORY FOR DURATION Brian C. Rakitin[1], Yaakov Stern[1]; [1]Columbia University — The timing abilities of healthy elderly (n=18, age = 75.5 ± 8.2), young sleep-deprived (n=27, age = 25.1 ± 3.8, 48 hours total SD) and young control participants (n = 16, age = 26 ± 3.8) were compared over three consecutive days. On day 1, participants acquired and reproduced 4.5 s and 7.5 s intervals with the assistance of feedback, and then reproduced them without feedback (i.e., in delayed free-recall) on days 2 and 3. Two tasks were used. In simple reproduction a single key was used regardless of the location of the timing cue. In choice reproduction, participants indicated the elapsed interval with a 4 alternative forced-choice spatial discrimination with and incompatible s-r mapping. Results indicated largely accurate reproduction in both tasks for all groups on day 1. However, whereas young participants over-produced the intervals in simple reproduction free-recall, elderly participants under-produced, while sleep-deprived participants reproduced most accurately. These results indicate a positive encoding bias (i.e., K*) for long-term memory for duration in young participants, and a negative encoding bias in elderly participants. The sleep-deprivation results most likely represent a conservative decision bias that counteracts the positive encoding bias. Choice reproductions were shorter, likely due to a non-specific arousal effect stemming from the greater task demands. More generally, these results emphasize that sleep-deprivation is a poor model of cognitive aging, and perhaps more importantly, that expectations of slowed performance in sleep-deprived individuals does not apply to planned behavior in intermediate time-scales.

G91

AUDIOVISUAL TEMPORAL INTEGRATION IN THE INFANT BRAIN Franziska Kopp[1], Ulman Lindenberger[1]; [1]Max Planck Institute for Human Development, Berlin — Research shows that the temporal window of audiovisual integration is about 300-350 ms in infants. However, looking time measures alone – as often used in infancy research – cannot fully exclude discriminative abilities when overt behavior is missing. Therefore, the aim of the present study was to investigate brain dynamics related to audiovisual integration in 6-month-old infants using event-related potentials (ERP). In a behavioral experiment, infants were habituated to a synchronous audiovisual stimulus. Once infants met the habituation criterion, an asynchronous test trial of the same stimulus was presented in which the visual stream was delayed to the auditory stream by 200 ms. Results showed that infants were not able to discriminate this asynchrony on behavioral level. In a subsequent EEG experiment, audiovisual film sequences were presented for 4000 ms in each trial. In synchronous trials the visual and auditory stream were in synchrony, whereas in asynchronous trials the visual stream was delayed to the auditory stream by 200 ms. ERPs revealed, in contrast to the behavioral data, that brain activity differed between the two conditions. In particular, Nc and P2 peak latencies differed in anterior electrodes. No latency differences were found in posterior electrodes. Results suggest that neural activity patterns might reflect an adaptation process for audiovisual temporal integration. A temporal shift of brain activity might be an adequate mechanism of the infant brain to integrate both modalities into a coherent percept.

G92

EYES ON THE TARGET: A COMPARISON OF FINE-GRAINED SENSITIVITY TO TRIADIC GAZE BETWEEN 8-10-YEAR-OLD CHILDREN AND ADULTS Mark Vida[1], Daphne Maurer[1]; [1]McMaster University — Adults are able to determine which object in the environment someone is looking at with high precision (triadic gaze). A previous study (Doherty et al., 2009) indicates that by age 6 children can detect large (10°) differences in triadic gaze. Here we developed a child-friendly procedure to compare sensitivity to small horizontal differences in triadic gaze between 8-10-year-olds (n=12 tested to date) and adults (n=18). Participants sat in front of a computer monitor on which they saw faces fixating a series of points (separated by 1.6°) that were physically marked on a board halfway between them and the monitor. The task was to indicate whether each face appeared to be looking to the left or right of one of three target points (center, 6.4° left or 6.4° right). Adults were highly sensitive to deviations from the central target, with a mean error of 0.83° (calculated from the .25 and .75 points on the fitted psychometric curves). The children were not as sensitive (M error = 1.70°). When the targets were peripheral, participants overestimated the degree to which the face was looking toward the periphery (e.g., judging the face to be looking to the left of the left target), with a larger error in children (M = 1.51°) than in adults (M = 0.91°). These results indicate for the first time that, by age 8-10, children can detect small differences in triadic gaze, but that sensitivity is not yet as refined as it will become in adulthood.

G93

PERCEPTION OF TEMPORAL FINE STRUCTURES IN SOUND WHILE WE AGE Bernhard Ross[1,2], Bruce Schneider[2], Claude Alain[1,2]; [1]Rotman Research Institute, [2]University of Toronto, Canada — Age-related decline in processing rapid fluctuations in sound contributes to older adult's difficulties in understanding speech. We investigated auditory temporal resolution in young, middle-aged, and older listeners with neuromagnetic evoked responses to gap stimuli of different leading marker (10 or 40ms) and gap duration (4 or 16ms) and no-gap stimuli of corresponding durations. Auditory cortex source activities at low frequencies (<24 Hz), around 40 Hz (gamma band) and around 80 Hz (high gamma band) were modulated accordingly to the perceptual difficulty in detecting the gap. Oscillatory 40-Hz responses were elicited by the onsets of leading and lagging markers and constituted markers for the central representation of the physical stimulus elements. Early 40-Hz oscillations were unaffected by age and were interpreted as related to the registration of the key acoustical features of sound primitives. In contrast, activity in the high gamma band, and low frequency responses with a latency around 200 ms declined significantly in the middle-aged and older groups, and were interpreted as reflecting higher order processes of grouping sound items into auditory objects and updating of memory for these objects. The results indicate that age-related changes in auditory acuity likely involve higher-order brain functions than previously thought.

G94

ACTION UNDERSTANDING IN AUTISM Lauren Marsh[1], Antonia Hamilton[1]; [1]University of Nottingham — Poor social cognition in autistic spectrum disorder (ASD) may extend to action understanding. The controversial broken mirror hypothesis of ASD predicts that people on the autistic spectrum will have specific deficits in understanding the actions of others. Previous studies assessing action understanding in autism have found contradictory results (see Dowell, Mahone and Mostofsky, 2009 and Hamilton, Brindley and Frith, 2007). The present study used an adaptation of a gesture understanding task developed by Mozaz et al (2002) which assesses understanding of transitive (object-directed) actions and intransitive (socially-directed) actions. Twenty three adults with ASD and 21 matched typical adults took part. Diagnoses were confirmed using the autism diagnostic observation schedule (ADOS, Lord et al., 2000). Results showed no significant difference in reaction times between groups or across action type. However, participants with ASD made more errors than typical adults on both transitive and intransitive action trials. Implications for the broken mirror hypothesis of autism are discussed.

G95

DO PEOPLE WITH WILLIAMS SYNDROME PROCESS FACES HOLISTICALLY? EVIDENCE FROM BRAIN ELECTROPHYSIOLOGY Ching-fen Hsu[1,2], Katherin Cohen-Kadosh[1], Jo Van Herwegen[3], Dagmara Annaz[1,4], Annette Karmiloff-Smith[1]; [1]Centre for Brain and Cognitive Development,

Birkbeck College, London, [2]Centre for Teacher Education, Huafan University, Taiwan, [3]Centre for Language Disorder and Communication, King's College, London, [4]Middlesex University, London — This study aimed at systematically investigating the processing of socially important facial information in individuals with Williams syndrome (WS). Previous studies of face identity had revealed a distinct pattern in WS compared to healthy controls, both electrophysiologically and behaviorally (Grice, Haan, Halit, Johnson, Csibra, Grant, & Karmiloff-Smith, 2003; Grice, Spratling, Karmiloff-Smith, Halit, Csibra, de Haan, & Johnson, 2001; Mills, Alvarez, George, Appelbaum, Bellugi, & Neville, 2000). The current study focused on three social factors (identity, emotion, eye gaze) in the same individuals, both behaviourally and electrophysiologically using high density Event Related Potentionals. The three factors called on distinct types of face processing: holistic, configural, and featural, respectively. Face images were presented consecutively, with 0 change, 1 change, 2 changes, and 3 changes across the three factors. Individuals with WS showed no difference to faces with a holistic or configural change, but displayed higher sensitivity to faces with featural changes. Further evidence came from differences in response latency and error rates in the behavioural task to holistic versus featural changes between controls and individuals with WS. Taken together, the behavioural and ERP data reveal that individuals with WS differ from controls in that their face processing is indeed more feature-based.

G96

PINPOINTING EMERGING EFFECTIVE CONNECTIVITY IN THE HUMAN BRAIN Kathrin Cohen Kadosh[1,2], Roi Cohen Kadosh[3], Frederic Dick[2], Mark H. Johnson[2]; [1]Institute of Cognitive Neuroscience, University College London, London, [2]Centre for Brain and Cognitive Development, School of Psychology, Birkbeck College, University of London, UK, [3]University of Oxford, UK — Little is currently known about the postnatal emergence of functional cortical networks supporting complex perceptual and cognitive skills, such as face processing. The current developmental fMRI study compared the emerging cortical network for face processing in 7-11 year-old children and adults. The participants did three fMRI target detection tasks where they had to detect a specific facial identity, expression or direction of eye gaze in a stream of consecutively presented faces. No significant behavioural differences were found for the three age groups in the different tasks. We then compared the "core-face-network" in children and adults using Dynamic Causal Modelling, and observed the gradual emergence of this network during childhood. We found that while the relative strength of functional connections in this network were differentially modulated by task demands in adults, there was no such modulation of the network in children. We suggest that this is due to continuous specialization and fine-tuning within the regions of the network and that our results have important implications for future studies investigating trajectories of cortical specialization both in typically and atypically developing populations.

G97

PERCEPTUAL ANCHORING AND EMERGENT LITERACY SKILLS IN KINDERGARTEN CHILDREN Karen Banai[1], Rachel Yifat[1]; [1]University of Haifa — The anchoring deficit hypothesis suggests that reading acquisition in dyslexia is compromised as a result of a more general deficit in implicitly forming or maintaining representations of repeated auditory (speech and non-speech) stimuli in active memory (Ahissar et al., 2006). The role of anchoring mechanisms in early reading skills, prior to formal reading instruction however, remains unclear. Here we tested the hypotheses that pre-reading children benefit from contextual information similarly to already reading individuals and that the degree of benefit is associated with emergent literacy skills. To that end a battery of auditory frequency discrimination, short term verbal memory, phonological awareness, rapid naming and letter identification tasks was administered to 37 kindergarten children (mean age 69±5 months). Frequency discrimination and verbal memory were tested twice – with and without stimulus repetitions. Similar to older children, both frequency discrimination and memory spans for syllables were significantly better in the repetition condition compared with the no-repetition condition. The amount of benefit in frequency discrimination was associated with verbal memory spans, but not with any of the other emergent literacy skills. On the other hand, children with better frequency discrimination in the no-repetition condition had better phonological awareness and verbal working memory skills and could recognize more letters than children with poorer frequency discrimination in that condition. Taken together these data suggest that like older children and adults, pre-reading children are sensitive to the perceptual context of stimulus presentation, but determining whether this sensitivity supports early reading development requires further studies.

G98

INCREASING INVOLVEMENT OF FRONTAL AND PARIETAL BRAIN REGIONS CHARACTERIZES DEVELOPMENT OF BOTH "DORSAL" AND "VENTRAL" STREAM FUNCTIONS Sarah Noonan[1,2], Frank Haist[2], Brianna Paul[3], Joan Stiles[2]; [1]San Diego State University, [2]University of California, San Diego, [3]University of California, San Francisco — Considerable research has shown that visual object and spatial processing in adults depend on relatively distinct neural systems. However, questions about the development of these processing systems remain largely unexplored. The current study employed well-matched working memory tasks for faces and locations to examine regional brain activation differences between children (n=15, 8-10 years) and adults (n=15, 19-29 years) using BOLD fMRI. In adults, the two tasks engaged a common set of distributed brain regions, including classic face processing areas in bilateral fusiform (FFA) and inferior occipital (OFA) gyri, as well as bilateral posterior parietal cortex. For both tasks, the child group engaged a more limited set of brain regions. Significant response to face processing was restricted to areas of bilateral ventral occipital temporal (VOT) cortex in children, including bilateral FFA and right OFA. Location processing in children recruited right superior parietal cortex and right VOT regions including the right FFA. Direct comparison of adults and children revealed that adults produced reliably greater activation in both tasks, predominantly in frontal and parietal regions. No areas of significantly greater activation for the child group were identified for either task. These results suggest that the rudiments for separate systems for face and location processing are evident in school-age children, but that the systems are far from fully mature. It appears that an important missing element in the child networks is long-range integration of higher-order frontal and parietal areas.

G99

ELECTROPHYSIOLOGICAL AND BEHAVIORAL INDICES OF TIME PERCEPTION Deana Davalos[1], Alana Campbell[1]; [1]Colorado State University — Timing is an important part of human behavior and cognition. Walking, information processing and planning all rely on temporal processes. The term temporal processing has historically encompassed a wide range of tasks that measure various facets of timing abilities. In addition, different timing tasks have involved varying degrees of attentional resources along with other cognitive processes, which makes the direct study of timing difficult. In an attempt to begin addressing these confounds, we used a pre-attentive event-related potential (ERP) called mismatch negativity (MMN), to investigate potential relationships between the behavioral and neurophysiological measures of temporal processing. We recorded brain activation using MMN to assess neural responses to changes in sub-second intervals in the absence of attentional demands. These same intervals were used in a behavioral discrimination task to explore the role of attention along with other cognitive processes that may be employed in behavioral measures of temporal processing. Brain activation (via amplitudes and latencies) was compared to behavioral performance using identical temporal intervals. Results suggest that not only are there significant differences between accuracy measured on behavioral tasks when compared to amplitudes measured via ERPs, there were also differences within the behavioral paradigm between performances on the temporal perception task (e.g.

less than 1000 milliseconds) and temporal estimation task (e.g. greater than 1000 milliseconds. These findings suggest that temporal processing is not likely a unitary construct and that there may be slight variations in the different neuroanatomical and cognitive processes that are employed in each type of temporal processing task.

G100

DEVELOPMENT OF VISUAL ORIENTATION DISCRIMINATION IN CHILDREN, TEENAGERS AND ADULTS Elise Labonte-LeMoyne[1], Annie Baillargeon[1], Mathilde St-Louis-Deschenes[1], Dave Ellemberg[1]; [1]University of Montreal — Little is known about the normal development of visual orientation discrimination in children. Previous studies demonstrate that adult orientation discrimination has still not been reached at age 5 (Lewis et al., 2007). The aim of this study was to investigate the development of orientation discrimination. Stimuli were white lines that were 8.5 cm long and 2 cm wide, presented against a black background. Using a 2-alternative forced-choice discrimination task, three groups of participants [children (8-10 years of age); teenagers (11-16 years of age); adults (> 18)] were asked to press a key every time the stimulus on the screen was tilted from the vertical orientation. The results indicate that discrimination accuracy was similar in children and teenagers when the stimulus had a 3° tilt for the 8-10 year-olds, a 2.5° tilt for the 11-16 year-olds. However, at a 2° tilt, the adults were more accurate than the younger groups. These data suggest that visual orientation discrimination is still undergoing maturational changes during adolescence. Further studies investigating more precise age groups are required to chart the development of visual orientation discrimination.

G101

SENSORI-MOTOR INTEGRATION IN CHILDREN: EFFECTS OF DIFFERENT FORMS OF TRAINING ON MELODY PROCESSING Elizabeth M. Wakefield[1], Karin H. James; [1]Indiana University — A developmental approach was taken to explore how recruitment of multiple brain systems influences how children learn, using functional Magnetic Resonance Imaging (fMRI). Specifically, we investigated how the activation of motor systems in the brain during the learning of sung melodies affected subsequent melody processing. Children (4-7 year-olds) learned novel melodies under 2 conditions, incorporating a motor or visual system component with an auditory system component. After training, participants heard and differentiated between learned and new melodies during an fMRI session. Neural activation patterns to melodies learned in each of the conditions were analyzed. Functional data indicated that upon subsequent melody presentation, melodies learned with motoric hand signs activated areas of the middle frontal gyrus, motor cortex, and right intraparietal lobule significantly more than melodies learned without a motor component. Behavioral data indicated that children more often correctly recognized learned melodies as learned (as opposed to new) if the melodies were taught with a motor component, as compared to a visual component; however, this result was not significant, most likely due to the small sample size. These results differ from results of a previous study in which the same paradigm was used with adults (Wakefield & James, in preparation), suggesting that children and adults recruit different brain systems while learning with multisensory input. Results of the present study have implications for understanding sensori-motor integration in the developing brain, and may provide insight into why the use of the motor system is stressed in some music education techniques.

Emotion & Social: Development & Aging

G102

CONNECTIONS BETWEEN MOTOR EXPERIENCE AND SOCIAL DEVELOPMENT IN THREE-MONTH-OLD INFANTS Klaus Libertus[1], Amy Needham[2]; [1]Duke University, [2]Vanderbilt University — Two abilities are necessary to successfully interact with other living beings: 1) the ability to detect social partners and 2) the ability to act on the environment. Human infants come prepared with two skills that facilitate such interactions: Newborns preferentially attend to faces (Johnson, Dziurawiec, Ellis, & Morton, 1991) and show object-directed arm movements (von Hofsten, 1984). Both behaviors show similar developmental trajectories where they decrease and reemerge around the same time (Maurer, 1985; von Hofsten, 1984). Based on these observations, we hypothesize that reaching behavior modulates face-preference behavior in young infants. We test this hypothesis by actively manipulating infants' reaching experience in two different ways. Active reaching experience affects both domain-specific development (i.e. manual exploration) and social orienting in three-month-old infants. Following a two-week enrichment period, infants who received active training showed more manual exploration of available 3-D objects ($F(2, 47) = 6.128$, $p = .004$) and also a significant preference for faces over toys presented on a computer screen ($t(16) = 2.65$, $p = .018$). In both their manual and visual exploration, these infants behaved similar to five-month-old infants. In contrast, object-directed but passive reaching experience in three-month-old infants does not affect face-preference behavior ($t(17) = .207$, $p = .839$). These results demonstrate the importance of self-produced motor experiences for social development and have implications for our understanding of the etiology of developmental disorders in social cognition.

Thinking: Other

G103

TIME COURSE OF STIMULUS-DRIVEN OSCILLATORY SYNCHRONIZATION AND ADAPTATION TO NUMERICAL CHANGES Melissa E. Libertus[1], Elizabeth M. Brannon[1], Marty G. Woldorff[1]; [1]Duke University — In a previous study, we successfully used a novel frequency-tagging paradigm to investigate the neural tuning to non-verbal numerical information. Adults passively viewed rapid streams of multiple-element images of a given numerosity that flickered at 12.5 Hz for 400 ms each while EEG was recorded. After six of these 400-ms flickering-image blocks with the same numerosity (i.e., 2400 ms), the number of elements changed by a 1:3, 1:2, or 2:3 ratio (e.g., from 8 to 24 elements). Analyses showed that the EEG power at the flicker frequency increased over repeated presentation of the same numerosity across the 2400-ms blocks over posterior scalp sites (synchronization effect). Moreover, the magnitude of this synchronization effect was modulated by the ratio of the numerosity switches. Here, we investigated the temporal dynamics of the synchronization effect further by employing three different block lengths: 2400 ms (as in the original study), 4800 ms, and 7200 ms. Again, adults passively viewed rapid streams of multiple-element images, but with the durations for each numerosity randomly varying between the three block lengths. The power at the flicker frequency again increased over 2400-ms blocks over posterior sites, replicating our previous findings. This increase in power continued until 4800 ms; however, no changes in power were observed between 4800 and 7200 ms (adaptation effect). Thus, the synchronization and adaptation effects together suggest a driven oscillatory stabilization of the neural network encoding numerosity for the first few seconds of the presentation of a novel numerosity, followed by a subsequent adaptation.

G104

COMPARISON OF SYMBOLIC AND NON-SYMBOLIC NUMERICAL REPRESENTATIONS IN THE HUMAN BRAIN Casey Murray[1], Elise Temple[1], Rick Granger[1]; [1]Dartmouth College — The representation of numerical magnitude has been argued to be an innate, pre-linguistic human capability that is present in rudimentary form in infants (Cantlon, et al, 2006) and in a host of animal species spanning phyla (Brannon & Terrace 2000.; Hauser et al, 2003; Kilian et al. 2003). Numerical information can be presented in multiple forms, including Arabic numerals (e.g., 3) written words (three), roman numerals (III), or non-symbolically, as in dot arrays (e.g., ?). It is not known how brain responses to these distinct inputs differ. We passively presented the numerals 1 through 9 in these four ways, using fMRI to investigate the similarities and differences of resulting brain responses. As in prior reports (Nieder & Dehaene, 2009), overlapping activations occurred in the horizontal intraparietal sulcus (hIPS), but clear differences were found in our side by side comparisons: (1) written words, roman numerals, and dot arrays all exhibited robust activation of hIPS, indicating that both symbolic and non-symbolic signals rely on the same circuitry; (2) Arabic numerals elicited significantly weaker hIPS activation, suggesting a possible difference between passive viewing in the present experiments versus prior investigations actively using numbers for comparison or arithmetic operations; (3) activation of the hippocampal complex was stronger for symbolic forms than for dot patterns, suggesting the triggering of a potential retrieval or spatial transformation process for symbolic but not for non-symbolic information. These findings represent the first side by side investigation of brain responses to multiple different kinds of number information.

G105

REPRESENTATIONS OF FRACTIONS WITHIN THE BRAIN Lisa Sprute[1], Elise Temple[1]; [1]Dartmouth College — The use of symbols has allowed humans to develop a numerical system that can evaluate exact quantities. Research on number processing uses the presence of a distance effect, characterized by longer reaction times and reduced accuracy in size judgments when the distance between numbers is small, as evidence for a spatial, analogue representation of number. Further, this representation of number has been shown to rely on the intraparietal sulcus (IPS) and lateral prefrontal cortex. Recent brain imaging studies have suggested that the IPS is also active when processing fractions. The present study extended these findings by examining the effect of distance during the comparison of fraction pairs that included many fractional magnitudes and discouraged processing of the fractions' whole number components. In a fast, event-related functional magnetic resonance imaging (fMRI) design twenty-two healthy adults compared randomly presented number pairs composed of simple, irreducible proper fractions. Distance between fraction pairs was close ($0 < x < 0.3$) or far (0.5 ? x <0.8). Data were collected on a 3T Phillips scanner using echo-planar imaging, while accuracy and reactions times were recorded. Whole brain coverage was achieved with 44 3 mm slices, 0 gap, and interleaved acquisition. Functional scans were followed by a 3D high-resolution anatomical scan. Results showed significantly more blood oxygenation level–dependent (BOLD) activity in the intraparietal lobule and lateral prefrontal cortex for close verses far distances. These results suggest that the fully developed representation of fractions relies on a parietofrontal network similar to whole numbers.

G106

THE IMPACT OF SEX AND GENDER IN VISUOSPATIAL SKILLS Joel Salinas[1,2], Amy Conrad[3], Peg Nopoulos[2,3,4]; [1]University of Miami Miller School of Medicine, [2]University of Iowa Doris Duke Clinical Research Fellowship Program, [3]University of Iowa Carver College of Medicine, [4]University of Iowa Neuroscience Graduate Program — Introduction: It is well-established that there are sex differences in particular cognitive skills. For example, several studies demonstrate that males are more adept in mental rotation and similar visuospatial tasks when compared with females. However, what has not been fully explored is whether gender modifies this effect (i.e., sex refers to biological traits [male/female] and gender to the behavioral or psychological traits that are typically associated with each sex). Methods: To investigate the relationship between visuospatial ability, sex, and gender, 54 males and 54 females aged 7-17 (matched for age and full scale IQ) were administered the Block Design (BD) task, a test of motor and visuospatial skills used in daily life, and the Children's Sex Role Inventory (CSRI), a self-rated scale of masculinity and femininity in children. Results: In this sample, there was no sex difference found in BD score between boys (mean=12.9, standard deviation=3.4) and girls (mean=12.3, standard deviation=2.6). The interaction, however, of sex and gender had a significant effect on the variance of BD scores (? = 1.101; $p < 0.003$). Identification with more masculine traits on the CSRI correlated with higher BD scores in girls ($r = 0.313$; $p < 0.05$). Additionally, higher degrees of femininity in boys correlated with better performance on the BD task ($r = -0.272$; $p < 0.05$). Discussion: These results suggest a complex relationship between gendered behavioral traits and visuospatial skills that may potentially be related to neurobiological sex differences in parietal lobe morphology of young males and females.

G107

PSYCHOLOGICAL STRESS PROCESSING IN YOUNG ADULTS WITH SUBCLINICAL LEVELS OF DEPRESSION: AN FMRI STUDY Katarina Dedovic[1], Annie Duchesne[1], Sonja Damika Lue[1], Julie Andrews[1], Simona Efanov[1], Veronika Engert[1], Thomas Beaudry[1], Jens C. Pruessner[1]; [1]Douglas Mental Health University Institute, McGill University — Background: Prolonged and chronic stress exposure has been suggested to contribute to development of depression. While several studies have investigated neural networks associated with the processing of psychological stress in normal populations, to our knowledge no study has directly investigated this in a population with an explicit vulnerability to depression, i.e. subclinically depressed individuals. In the present study, we examined the neural correlates of stress exposure in a group of healthy university students showing individual differences at the levels of subclinical depression. Methods: We recruited 64 healthy college students (33 males) based on their scores on the Beck Depression Inventory (BDI). Two groups were formed: a control (CTRL) (BDI?9) and a subclinical group (SUB) (10?BDI?18). Participants completed additional psychological questionnaires to assess their personality profiles. Subjects completed two functional runs of the Montreal Imaging Stress Task (MIST). Saliva samples were taken throughout the experiment to assess stress reactivity. Results: Additional depression questionnaires revealed that nine subjects scored at clinical levels of depression, forming a third group of high-scoring subclinicals (hSUB). A mixed-design ANOVA yielded a significant Group x Time interaction ($F=3.054$, $p=.007$), with CTRLs having higher cortisol levels compared to the SUBs in response to the MIST, but not differing from hSUB group. The fMRI analysis is in progress, and results will be presented at the meeting. Conclusions: Investigating the psychosocial stress processing in a subclinical population is essential for better understanding the ways in which dysregulation of specific processes may represent a vulnerability in the illness proper.

G108

THE NEURAL SUBSTRATES OF CONCEPT FORMATION I: A BEHAVIORAL PARADIGM John Foxe[1,3,4], Aaron Krakowski[1,3,4], Ariel Nemzeyano[2], Adam Snyder[1,3,4], Inna Prehogan[2], Lanny Fields[1,2]; [1]The Graduate School of the City University of New York, [2]Queens College of the City University of New York, [3]The City College of the City University of New York, [4]The Cognitive Neurophysiology Laboratory, Nathan S. Kline Institute for Psychiatric Research, Orangeburg, NY — The ability to classify stimuli enables individuals to respond effectively to different representations of the same event as encountered in real world settings. After learning relations between some stimuli by training, subjects recognize relations among stimuli that were not trained. For example, after learning relations between the pseudo-words 'mok' and 'fow', 'fow' and 'jor', and `jor` and `kop`, individuals immediately recognize relations between 'mok' and 'jor', and `mok' and `kop`, without training. When that occurs, all four pseudo-words are functioning as an equivalence class. The `mok-jor` relation is said to be 'transitive' with the pseudo-words linked by one node, while `mok` and `kop` are indirectly linked by two nodes. Behavioral data show that the strengths of 1- and 2-node relations are inverse functions of nodal separation. Thus, they should engender different neural substrates. The following protocol enabled us use ERPs to measure these neural differences. Equivalence classes were formed using trials that contained two separately presented stimuli, followed by a response window. YES and NO responses were correct on within- and cross-class trials, respectively. All subjects formed classes. Whether a trial contained stimuli from the same or different classes could be determined only during the second stimulus in a trial. Thus, ERPs produced by the second stimuli in all trials were used to document the neural substrates of 0-, 1-, and 2-node relations. The details of class formation are presented in this poster. The ERP data are in the "The neural substrates of concept formation II."

G109

THE NEURAL SUBSTRATES OF CONCEPT FORMATION II: HIGH-DENSITY ELECTRICAL MAPPING OF EQUIVALENCE CLASSES Lanny Fields[1,2], Aaron Krakowski[1,3,4], Ariel Nemzeyano[2], Adam Snyder[1,3,4], Inna Prehogan[2], John Foxe[1,3,4]; [1]The Graduate School of the City University of New York, [2]Queens College of the City University of New York, [3]The City College of the City University of New York, [4]The Cognitive Neurophysiology Laboratory, Program in Cognitive Neuroscience and Schizophrenia, Nathan S. Kline Institute for Psychiatric Research, Orangeburg — The ability to classify stimuli enables individuals to respond effectively to different representations of the same event as they are encountered in real world settings. This ability involves learning relations between stimuli by explicit training, and also to infer relations that have not been explicitly trained. For example, after learning relations between the pseudowords 'mok' and 'fow', 'fow' and 'jor', and `jor` and `kop`, an individual will immediately recognize that 'mok' and 'jor' are related, as are `mok' and `kop`, without any direct training. When that occurs, all four pseudo-words are functioning as an equivalence class. The emergence of the `mok-jor` relation is said to be 'transitive' with 'mok' and 'jor' connected by one common node, while `mok` and `kop` are indirectly linked by two nodes. We trained subjects using such pseudoword relations and then compared ERPs between 0-node, 1-node and 2-node relations. There were clear differences over both prefrontal and lateral occipital regions. One and two-node relations produced large enhancements of activity over the left dorso-lateral pre-frontal cortex, likely indicating large-scale recruitment of working-memory processes. In contrast, over lateral-occipital visual regions there was evidence for sustained increases in activity for 0-node and 1-node relations, but not for 2-node relations. This likely reflects the fact that the implicit relations between word-pairs in the 1-node condition have begun to be more deeply encoded in sensory-perceptual areas, whereas this process has not yet occurred for the more weakly associated 2-node relations, which continue to rely on more frontal cognitive circuits.

G110

INVESTIGATING MIND-WANDERING AND ATTENTION DURING FOCUSED MEDITATION USING FIRST-PERSON SUBJECTIVE INFORMATION Wendy Hasenkamp[1,2], Christine Wilson-Mendenhall[1], Erica Duncan[2,3], Lawrence Barsalou[1]; [1]Emory University, [2]Atlana VA Medical Center, [3]Emory University School of Medicine — Studies have suggested that the default mode network (DMN) is active during states of mind-wandering (MW), which is experienced at rest, or intermittently while attempting to maintain focused attention (FA). People who train in FA meditation improve their abilities to monitor distinct processes related to attention and distraction. Subjective report of meditators' mental experience in real time is a tool that can be used to identify neural correlates of MW during meditative states, and the dynamic shifts between attention and MW. Experienced meditation practitioners underwent fMRI scanning while focusing on the breath (a common form of FA meditation). Whenever participants realized their mind had wandered away from the breath, they pressed a button and returned their focus to the breath. We then used this first-person behavioral data to direct our fMRI analysis, which examined the brain networks active during MW (just before the button press) and return to FA (just after the button press). Analysis revealed elements of the DMN active during self-identified states of MW, and elements of fronto-parietal attention networks active upon re-focusing of attention. Furthermore, patterns of brain activity in these states were dependent on the amount of lifetime meditation experience. Thus, by leveraging the ability of meditators to report on their conscious experience, we were able to separate distinct brain states of attention and MW that are normally experienced in a fluctuating manner. Such neurophenomenological paradigms are useful for studying the cognitive correlates of DMN, as well as the neural correlates of meditation practices more generally.

G111

ABERRANT DEFAULT NETWORK ACTIVATIONS DURING VERBAL THOUGHT GENERATION MAY CONTRIBUTE TO HALLUCINATIONS IN SCHIZOPHRENIA Lucile Rapin[1,2,3], Jennifer Whitman[2,3], Paul Metzak[2,3], Todd Woodward[2,3]; [1]Grenoble University I, Grenoble, France, [2]University of British Columbia, Vancouver, Canada, [3]BC Mental Health & Addictions Research Institute, Vancouver, Canada — Schizophrenia, particularly hallucinations, has been associated with impairments in source monitoring, whereby hallucinating patients tend to misattribute the source of a speech event to an external agent. Previous research proposed that abnormalities in generating thoughts may induce more vivid auditory sensations, which could account for misattribution from an internal to external source, possibly leading to auditory verbal hallucinations. In the present study, we investigated the neural underpinnings of a verbal thought generation (VTG) task using fMRI in 12 healthy controls and in 5 schizophrenia patients (DSM-IV). Two conditions were examined. In the first condition, participants were required to mentally generate a definition of a frequent word presented on the screen. In the second condition, participants were required to listen to the definition of a frequent word presented on the screen. An event-related fMRI protocol was used over 2 sessions of 8 minutes each. Analysis using constrained principal component analysis with a finite impulse response (FIR) model indicated that, during the mental generation task, default network regions including bilateral posterior cingulate cortex (BA 30-31), medial frontal gyrus bilaterally (BA10) and left precuneus (BA 7-19) showed less complete deactivation in schizophrenia patients relative to healthy controls. No group differences were found in task-positive networks, or the listening only condition. These results suggest abnormalities in the default network associated with the generation of thoughts, which may play a part in the genesis of auditory verbal hallucinations.

Thinking: Development & Aging

G112

NEURAL SPECIALIZATION PREDICTS FLUID PROCESSING ABILITY (BUT NOT CRYSTALLIZED KNOWLEDGE) IN OLDER ADULTS Joonkoo Park[1], Joshua Carp[1], Andrew Hebrank[2], Denise Park[2], Thad Polk[1]; [1]University of Michigan, [2]University of Texas, Dallas — Measures of fluid processing ability tend to decline with age. Nevertheless, some older adults show comparable performance to young adults. What distinguishes older adults who continue to perform well from older adults who do not? One possibility is neural specificity, the distinctiveness of different neural representations, which has been hypothesized to influence behavioral performance. In this study, we investigated whether individual differences in neural specificity could explain individual differences in cognitive performance in older adults. Older adults completed a battery of fluid processing tasks (digit-symbol, dot-comparison, verbal-fluency, trails-A, trails-B) as well as a test of crystallized knowledge (Shipley vocabulary). Neural activation was also estimated using functional MRI in visual (same-different judgments on faces and houses) and motor (left and right finger tapping) tasks. Neural specificity was estimated based on how accurately different experimental conditions could be distinguished from their patterns of neural activation using multivoxel pattern analysis. Neural specificity in both visual and motor tasks was significantly correlated with performance on a variety of fluid processing tasks, but not with the measure of crystallized knowledge. In fact, neural specificity of visual and motor activity together explained roughly half the variance in a composite measure of fluid processing ability (constructed from a principal component analysis of the five individual measures). These results provide direct evidence that neural specificity affects fluid processing ability in older adults.

G113

NOT SO DEFAULT? MODULATION OF THE DEFAULT NETWORK BY TASK DEMAND IN OLD AND YOUNG Brian Gordon[1,2], Carrie Brumback[3], Gabriele Gratton[1,2], Monica Fabiani[1,2]; [1]University of Illinois, [2]Beckman Institute, [3]University of California, Irvine — Very early on, studies using Positron Emission Tomography (PET) and functional magnetic resonance imaging (fMRI) noticed areas that not only increased with task, but also those showing a decrease. These clusters of deactivation came to be loosely referred to as "the default network" (Shulman et al., 1997). This network has at different times been linked to mind wandering (Mason et al., 2007) and mental self-projection (Buckner and Carroll, 2007). Although this phenomenon has received large amounts of scientific interest, much remains unknown. The relationship between default network activation and task performance has not been systematically investigated. To perform well on a behavioral task, it stands to reason that the resources much shift away from the default network. Additionally, the homogeneity of the network itself remains to be determined. In the current study, a Sternberg memory task was varied in difficulty in a blocked fashion for both older and younger participants. The modulation of the default network by working memory load was examined across several regions of interest. We modeled both a mean pattern of deactivation as well as linear decreases associated with load. Several patterns emerged, with some areas showing both a mean decreases as well as a linear effect (LOC, Parasylvian fissure, bilateral parietal areas) while others were minimally modulated by load (precuneus, lingual gyrus, middle frontal gyrus). Both old and young demonstrated this phenomenon, but the young had more robust deactivation. We then applied independent-component analysis to decompose the overall mean deactivation pattern into sub-networks for both groups.

G114

PROCESSING OF MUSICAL STRUCTURE IN AUTISM SPECTRUM DISORDER Eve-Marie Quintin[1], Anjali Bhatara[2], Hélène Poissant[1], Éric Fombonne[3], Daniel Levitin[2]; [1]Université du Québec à Montréal, [2]McGill University, [3]Montreal Children's Hospital — This study aimed to test central coherence (Happé & Frith, 2006) and enhanced perceptual functioning (Mottron et al., 2006) theories of ASD using musical stimuli. Although both theories recognize intact or enhanced local processing in ASD, the former stipulates that this will impede global processing whereas the latter suggests that global processing will be spared or enhanced. Children and adolescents (N=24; 7-17 years) with typical development (TD) or with ASD (N=24; 10-19 years) were asked to solve a musical puzzle made of 5 plastic cubes, each playing a segment of a melody. In the first condition (creation), participants arranged the blocks in the order they thought sounded best. In the second condition (replication), participants replicated a musical excerpt they had listened to twice. For both conditions, there was no significant difference between groups (ASD vs TD) for response times or for number of pieces of the puzzle that were placed in the correct location or in the correct sequence independently of location. Potential covariates, such as chronological age, verbal and performance IQ and musical knowledge and ability were considered. The effect of PIQ was significant but, when this effect was controlled for, the difference between groups remained nonsignificant. Although more evidence is needed to assess musical processing in adolescents with ASD, global processing in ASD does not seem to differ from adolescents with TD. These results fail to support weak central coherence and are more consistent with the account suggested by the enhanced perceptual functioning theory.

G115

THE FEEDBACK-RELATED NEGATIVITY (FRN) IN ADOLESCENTS Tina M. Zottoli[1,2], Jillian Grose-Fifer[1,2]; [1]John Jay College of Criminal Justice, [2]City University of New York, Graduate Center — Increased risk taking in adolescence may be due, in part, to immature incentive processing. A simple gambling task was used to compare the feedback-related negativity (FRN) and P300 in adolescents and adults. The FRN is thought to reflect the coarse evaluation of the motivational significance of events. To our knowledge this is the first normative study of the FRN during adolescence. Consistent with previous research in adults, the results showed that the feedback-P300 was sensitive only to the magnitude of the feedback (F(25,1)= 18.34, p<.0001, ?p2=.423); whereas the FRN was larger to losses than to gains (F(25,1) = 51.01, p<.0001, ?p2=.671).This was true for both adults and adolescents. However, an interaction between magnitude and valence was present only in adolescents, whose FRNs for small wins were similar to those elicited by loss trials (F(11,1)=13.304; p=.004, ?p2=.537).This may reflect a difference in adolescent incentive processing (i.e., a small win may be viewed as a negative event). This view is consistent with fMRI studies examining reward processing in adolescents. Adolescents were also more likely than adults to make risky gambles. Furthermore, participants with larger FRNs were more likely to make safer choices after a loss. Our results indicate that the neural mechanisms that aid rapid identification of good versus bad events, as reflected by the FRN, are still developing during adolescence. Immaturity in the ability to process feedback and adapt behavior accordingly may contribute to the increased propensity of risky behavior in adolescents.

Thinking: Problem Solving

G116

ELECTROPHYSIOLOGICAL CORRELATES OF INDIVIDUAL DIFFERENCES IN MENTAL ARITHMETIC AND NUMBER COMPARISONS OBSERVED IN MIDDLE SCHOOL CHILDREN: AN EVENT-RELATED POTENTIAL STUDY Joshua J. White[1], Matthew R. Brier[2], Rebecca R. Egbert[1], Michael A. Motes[2], Thomas C. Ferree[3], John Hart Jr.[2], Michael A. Kraut[4], Mandy J. Maguire[1,2]; [1]Callier Center for Communication Disorders, University of Texas, Dallas, [2]Center for Brain Health, [3]The University of Texas Southwestern Medical Center, [4]The Johns Hopkins University School of Medicine — Mental arithmetic is a complex cognitive skill. While many children acquire mathematical concepts well, many others struggle but the source of this difference is unknown. Seventeen 13-year-olds observed arithmetic statements presented with one character on the screen at a time (e.g., 4+4=8 or 4+4<10) while ERPs were collected. The problems contained either an equal sign or a less than sign, and ended with a correct answer, a nearby incorrect answer, or a distant incorrect answer. During the presentation of the first number, plus sign, and second number, a PCA revealed that numbers elicited a more negative ERP deflection than the plus sign over frontal regions at 450 msec after each stimulus. The size of this effect was correlated with reaction time, reflecting how efficiently number representations are encoded during a problem. The neural responses to the final number revealed two significant effects: 1) Following an equals sign, correct and incorrect answers elicited ERP amplitude differences over left frontal regions at 300 msec, and 2) Following a less than sign, correct and incorrect answers elicited ERP amplitude differences over parietal regions at 400 msec. In each case, the amplitude difference between the correct and incorrect answers was correlated with accuracy. These findings indicate that the best performers may have identified explicitly the correct answer, and established an efficient method to compare that answer with the candidate answer. By identifying the neural correlates of arithmetic performance in middle school children, it may also be possible to monitor changes with development and training.

G117

THE INFLUENCE OF LEFT TO RIGHT NUMBER REPRESENTATIONS ON NUMBER COMPARISON Matthew Brier[1], Mandy Maguire[1], Nistha Jajal[1], Thomas Ferree[2], John Hart[1], Michael Kraut[3]; [1]University of Texas, Dallas, [2]University of Texas Southwestern Medical Center, Dallas, [3]Johns Hopkins — Performing basic arithmetic procedures requires that multiple processes co-occur contemporaneously and in a coordinated manner. One such process is that of number comparisons. Previous research has found that performance on number related tasks is improved if the magnitude of the presented numbers increases from left to right. How this effect influences formal number comparisons is still unclear. This study uses behavioral and EEG measures to investigate how the direction of the presentation of numbers (i.e., magnitude increasing left to right or right to left) interacts with judgments of statement correctness. Previous studies have required the subject to press a button corresponding to the larger or smaller number. This study, however, requires the subject to indicate if an expression is correct (e.g., 3<4) or incorrect (e.g., 4<3). This study found that expressions where magnitudes increased left to right exhibited less theta band activity over right frontal regions compared to expressions where magnitude increased right to left which is consistent with previous proposals that left to right orientations are easier to process. Further, the condition where the expression is correct and magnitude increases left to right shows less alpha desynchronization over frontal regions compared to all other conditions indicating less processing is required to process statements that are both correct and presented left to right. Compared to simple number comparisons that can by handled entirely in the parietal lobe, comparisons involving an operator demonstrate frontal involvement that is sensitive to both the correctness of the expression and the direction it was presented.

G118

CONCEPTUAL COMBINATION AND NOVEL IDEAS: HOW PROPERTIES OF THE TASK AND TAUGHT BEHAVIORAL STRATEGIES INFLUENCE LEVELS OF EMERGENCE IN NEW IDEAS Catherine M. Mulvenna[1], Steven M. Smith[2]; [1]University of California, Los Angeles, [2]Texas A & M — Conceptual combination is a key process in creative cognition. It involves combining previously known concepts in order for new concepts to be generated. This processes is used in a multitude of situations, from brain storming techniques, to the evolution of art and science. Combined concepts can be judged for newness or 'emergence', by whether they possess features that are unique, and not shared with either of the parent concepts. Properties of the parent concepts have been manipulated in previous experiments (e.g. similarity of the concepts), and can result in different levels of emergence. However, less understood are the different behavioral strategies that could be employed by individuals engaging in conceptual combination. In the present study, participants (n=73) generated definitions to novel noun-pairs (e.g. 'motortcycle carpet,') and then generated feature lists for each definition, in a replication of a previous paradigm (Wilkenfeld & Ward, 2001). Overall, conceptual combinations that consist of dissimilar categories led to significantly more creative emergence, replicating previous findings. Three new behavioral strategies relating to 'feature focus' were taught to three separate groups. Data revealed significantly more creative emergence for medium and high levels of feature focus, compared to the low level. This was observed across both similar and dissimilar combinations. The details of the different behavioral strategies and their significance to creative cognition are discussed.

G119

CREATIVE COGNITION BENEFITS FROM INCUBATION WITH NEUROFEEDBACK Henk Haarmann[1], Timothy George[1], Joseph Dien[1], Jeffrey Chrabaszcz[1], Alex Smaliy[1], Suzanne Freynik[1], Jared Novick[1]; [1]University of Maryland, College Park — We tested whether incubation with neurofeedback improves creative verbal problem solving on the remote associates test (RAT). Previous studies with the RAT have shown that incubation helps overcome mental impasses (Smith & Blankenship, 1991) and that insight solutions are preceded by increased power in alpha brain waves over the right parietal-occipital cortex at sensor location PO8 (Jung-Beeman et al., 2004). Seventy-six healthy adults completed two RAT blocks in this study. The first test block was made difficult by presenting many items at a fast rate and by presenting an item's cue words together with distracting strong associates. The second test block provided an opportunity for participants to solve RAT items that were not solved during the first test block and indicate whether solutions arose with or without insight. The two RAT blocks occurred in immediate succession in a control condition, but were separated by a period of electroencephalographic (EEG) neurofeedback in two incubation conditions. The neurofeedback was aimed at either decreasing or increasing alpha power over PO8. Behavioral results revealed an incubation effect, i.e., greater benefit of second test block in the increase- and decrease-alpha neurofeedback conditions than in the non-incubation control condition. The incubation effect was particularly robust in the increase-alpha neurofeedback condition. The EEG spectral results revealed that the increase-alpha condition differed in two respects from the decrease-alpha condition: a progressive increase in alpha power and overall greater beta power during neurofeedback training. These results suggest that neural oscillatory states play an important role in creative cognition.

G120

HEMISPHERIC DISSOCIATION OF NUMERICAL FUNCTIONS IN CHILDREN WITH FOCAL BRAIN INJURY Leila Glass[1,2], Sarah Zelonis[2], Anjan Chatterjee[1,3], Sabrina Smith[1,2,3]; [1]Center for Cognitive Neuroscience, University of Pennsylvania, [2]Division of Neurology, Children's Hospital of Philadelphia, [3]University of Pennsylvania — Performance of precise mathematical tasks has been localized to the left parietal lobe in adults, while numerical approximation has been localized to the right parietal lobe. Little is known about the neural correlates of these functions in children, who are developing mathematical skills. The purpose of this study was to assess how brain injury affects performance of precise and approximate calculation and quantity estimates in children. Approximate numerical ability was evaluated using computer tasks (representational and symbolic quantity estimates and approximate calculation). Precise calculation and quantity estimation was assessed using a standardized measure of mathematical achievement (WIAT -II). Clinical brain MRI scans were reviewed to determine lesion location. Nine children (9-16 years) with chronic unilateral brain injury (5 right, 4 left) and 41 age-matched controls participated. Single case analysis compared individual brain injured subjects to controls. Impaired approximate performance was defined by t-statistic <-1.65 (1-tailed $p < 0.05$) on at least one approximation task, and impaired precise performance was defined by composite standard score of < 80 on WIAT-II. Three of five right hemisphere injured subjects had impaired approximation but average WIAT-II scores (mean =96). Two of four left hemisphere injured subjects showed deficits on precise tasks, yet approximation remained intact. Parietal lobe injury was found in only 2 of 5 affected subjects. Therefore, a subset of pediatric subjects demonstrated a hemispheric dissociation for numerical abilities, with left injury associated with impaired precise numerical functions and right injury associated with impaired approximation. Impairment was not specific to parietal lobe injury.

G121

MUSICIANS ARE MORE SUSCEPTIBLE THAN NON-MUSICIANS TO DIRECT CURRENT STIMULATION DISINHIBITING BROCA'S AREA AND IMPROVING MENTAL ROTATION PERFORMANCE Carlo Cerruti[1,2], Gottfried Schlaug[2]; [1]Harvard Graduate School of Education, [2]Beth Israel Deaconess Medical Center, Harvard School of Medicine — Transcranial direct current stimulation (tDCS) modulates regional brain activity and is an important tool of research. However, little is known about how stimulation differs across different kinds of subjects. Musicians have been shown to engage Broca's area more than non-musicians when doing 3D mental rotation (Sluming, 2007), and thus we examined MR performance after several stimulation protocols in musicians and non-musicians. We found a main effect of stimulation type over Broca's in the left hemisphere. Anodal stimulation, which increases neural activity, improved MR reaction time across all subjects. Comparing musicians v. non-musicians revealed a different pattern of interest. Musicians but not non-musicians were significantly aided by cathodal stimulation of Broca's right-hemisphere homologue. Cathodal stimulation hyperpolarizes neurons and decreases activity. We thus interpret this as a disinhibition effect: decreased activity in Broca's homologue also decreases interhemispheric inhibitory projections. These findings develop insight into the complex interactions, both facilitatory and inhibitory, among distributed processing regions during complex cognition. The data extends our lab's previous findings of interhemispheric disinhibition in motor performance and semantic verbal categorization. This is the first tDCS study we know of to examine how individual characteristics (musicianship) affect susceptibility to the brain's reaction to direct stimulation. Moreover, this is the first study to use multi-level regression to examine the role of multiple predictors (e.g. age, sex, verbal and spatial IQ) on different stimulation protocols (hemisphere, polarity of stimulation). Because tDCS research is still in its infancy, building such a knowledge base is critical for theory-driven research and effective interventions.

G122

WHEN TWO PLUS TWO DOES NOT EQUAL FOUR: EVENT-RELATED POTENTIAL RESPONSES TO INCONGRUOUS ARITHMETIC WORD PROBLEMS Kristie Fisher[1], Miriam Bassok[1], Lee Osterhout[1]; [1]University of Washington — People often need to integrate a series of items into a meaningful whole (e.g. words into a sentence). This conceptual integration process can be disrupted when one item is semantically incongruous with the others. Extensive research measuring event-related brain potentials (ERPs) shows that such items elicit a more negative electrical potential, peaking at around 400ms, when compared to congruent items (N400 effect). The N400 effect is elicited by semantically incongruous words in sentences and by incorrect answers to verbal and symbolic arithmetic problems. To explore how these two domains interact, we recorded ERPs as participants verified the correctness of simple addition and division word problem sentences (e.g., "Twelve roses plus three daisies equals fifteen"). We manipulated the correctness of the mathematical answers and the semantic congruence of the objects. Previous work in problem solving shows that, based on their "real world" experience, people tend to perceive categorically-related objects as being congruent with the addition operation (e.g., roses plus daisies) and thematically-related objects as being congruent with the division operation (e.g., roses divided by vases). We therefore hypothesized that the perceived correctness of a problem's answer would be modulated by whether or not the problem's objects matched well with its operation. Indeed, incongruous objects caused correct answers to elicit "incorrect answer" ERP responses; likewise, certain types of incorrect answers elicited "correct answer" ERP responses. Thus, in order for arithmetic word problems to be processed fluently, the problems must be mathematically sound as well as make sense in the "real world."

Attention: Nonspatial

H1

ORIENTING ATTENTION IN TIME ACTIVATES LEFT INFERIOR PARIETAL CORTEX FOR PERCEPTUAL, AS WELL AS, MOTOR TASK GOALS Karen Davranche[1], Bruno Nazarian[2], Franck Vidal[1], Jennifer Coull[1]; [1]Université de Provence et CNRS, Marseille, France, [2]CHU La Timone, Marseille, France — Temporal and motor attentional orienting have previously been shown to activate very similar regions of left inferior parietal cortex. Since temporal orienting benefits were indexed by motor response speed, this neuroanatomical overlap could potentially reflect incidental recruitment of motor orienting during these tasks. However, if left parietal cortex activation is a true reflection of temporal orienting, it should also be observed in tasks with perceptual, rather than motor, task goals. Fifteen participants performed both a motor detection task, in which targets were detected as quickly as possible with a button-press, and a perceptual discrimination task, in which targets were discriminated from among a rapid serial presentation of visually similar distractors. All trials were preceded either by (i) temporal cues, which predicted that the target would appear after either short (600 ms) or long (1380 ms) cue-target intervals, or (ii) neutral cues, which provided no information concerning the length of the cue-target interval. As compared to neutral cues, temporal cues significantly improved both detection speed and perceptual discrimination. In the motor detection task, temporal cues activated bilateral premotor cortex and left inferior parietal cortex, confirming previous findings. Critically, temporal cues also preferentially activated left inferior parietal cortex in the perceptual discrimination task. Conjunction analysis formally revealed that motor and perceptual temporal cues, as compared to neutral cues, activated a shared network, comprising supramarginal gyrus and intraparietal sulcus. These results indicate that left inferior parietal cortex represents a core neural substrate for the orienting of attention in time, independent of task context.

H2

DISTINGUISHING ACTIVITY ELICITED BY INTRINSIC SALIENCE IN THE FRONTOPARIETAL NETWORK USING AN ODDBALL PARADIGM WITH NATURAL SCENES Norberto Eiji Nawa[1], Hiroshi Ando[1]; [1]Universal Media Research Center, National Institute of Information and Communications Technology — Oddball targets that infrequently interrupt a monotonous stimuli stream reliably engage a frontoparietal network thought to subserve the detection of salient stimuli in the environment. Less clear is how activity elicited by the occurrence of relevant stimuli that are temporally unusual ('rare'), compare to responses evoked by relevant stimuli with unusual intrinsic features ('strange'). To investigate that, we measured hemodynamic brain activity using functional magnetic resonance imaging (fMRI) while participants performed two identical versions of the oddball task, one using intact photographs of natural scenes as targets and distractors, and another using scrambled photographs. Half the photographs were manipulated resulting in scenes and scrambles with abnormal colors. In the temporal dimension, targets were equally salient across tasks; however, in the semantic dimension, natural scenes with abnormal colors were more salient targets than natural scenes with normal colors. We examined neural responses in core regions of the frontoparietal network: the inferior frontal gyrus (IFG), specifically, BA 44/45, and the temporoparietal junction (TPJ). Results confirmed that in both tasks, increased activation was elicited by the oddball stimuli in the regions of interest. Further analysis revealed that abnormal color scenes elicited greater activation than normal color scenes only in the right BA 45. These results are in line with the hypothesis that the IFG subserves processes involved in the detection of salient stimuli, but also suggest that differential recruitment occurs depending upon the nature of salience, signaling a further functional specialization within the IFG.

H3

FEATURE RELEVANCE OR SIMILARITY: DISSOCIATING MECHANISMS OF GLOBAL FEATURE-BASED SELECTION WITH ELECTROMAGNETIC BRAIN RECORDINGS Rowena Bondarenko[1], Hendrik Strumpf[2], Christian M. Stoppel[2], Mircea A. Schoenfeld[1,2], Carsten N. Böhler[3], Jens-M. Hopf[1,2]; [1]Leibniz-Institute for Neurobiology, Magdeburg, Germany, [2]Otto-von-Guericke-University, Magdeburg, Germany, [3]Center for Cognitive Neuroscience, Duke University, Durham, NC — Feature-based attention is known to operate in a spatially global manner: the selection of a task-relevant feature in an attended object is associated with the parallel selection of that feature in other unattended objects. Here we show with electromagnetic brain recordings that this form of global selection outside the focus of attention can be dissociated into different operations that occur in a temporal sequence. Subjects discriminated the orientation of a target grating (vertical/horizontal) in one visual field while irrelevant gratings, that gradually changed orientation between vertical and horizontal, were presented concurrently in the unattended visual field. The electromagnetic response to the unattended gratings showed a modulation reflecting the operation of global feature-based attention. Importantly, this modulation was bimodal with an initial phase (~130-200 ms) reflecting the degree to which the distractor orientation matched either of the task-relevant response alternatives, and a subsequent phase (~250-500 ms) reflecting the similarity of the distractor orientation with the orientation of the target that was actually presented on a given trial. These observations indicate that global feature-based selection involves a sequence of operations, in which the selection based on task-relevant features has (temporal) priority over the selection based on sensory similarity with the target.

H4

MEASURING THE TIME COURSE OF TEMPORALLY SELECTIVE ATTENTION William S. Bush[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst — Behavioral and event-related potential (ERP) studies have demonstrated that temporally selective attention is used to preferentially process critical stimuli when an overwhelming amount of information is presented rapidly. However, these studies only provide information about the allocation of attention to the discrete times at which probe stimuli were presented. In the current study, steady state visual evoked potentials (SSVEPs) were employed as a continuous measure to determine how attention is allocated leading up to and following cued times. In separate blocks, participants were directed to attend to a time 500, 1000, or 1500 ms after the onset of a warning tone to detect rare, deviant digits presented in rapid serial visual presentation (RSVP) streams primarily composed of letters. The entire visual presentation was flickered at 17 Hz. Temporal attention modulated the amplitude of the SSVEPs over posterior brain regions. Specifically, SSVEP amplitude increased until the attended time, and then decreased relative to the longer attention conditions. However, the changes in amplitude were asymmetric and the rate of change differed for the three attention conditions. These results support previous findings that temporally selective attention modulates the same early stages of visual processing as spatially selective attention when perceptual systems are overwhelmed by too much information. Further, they provide the first evidence of precisely how the resources of temporal attention are allocated over time under specific conditions, and demonstrate the promise of SSVEPs to provide a continuous index of temporally selective attention under a wide range of cuing and stimulus presentation paradigms.

H5

CAN VIGILANCE BE IMPROVED WITH A RISKY DUAL-TASK: ELECTROPHYSIOLOGICAL AND PERFORMANCE EVIDENCE Paul Atchley[1], Sabrina Gregersen[1], Mark Chan[1]; [1]University of Kansas — It has been clearly established that engaging in a dual-task while driving, such as talking on a phone, is a risky behavior. However, another threat to safety, especially on long drives, is a loss of vigilance. We investigated if we could see either behavioral or physiological indicators of a sparing of vigilance during the course of a long drive in which some participants were allowed to talk on a phone while driving. Participants drove for ninety minutes in a boring, simulated, environment. Participants either engaged in a verbal task during the last ten minutes of the drive, a verbal task in the first ten minutes followed by an intermittent verbal task every two minutes, no conversation, or listened to the radio. Electroencephalographic (EEG) activity and driving performance (steering control and reaction to an unexpected event) were measured. The performance data indicted a loss of vigilance over time, as expected. This was worst in the late conversation case. Increasing alpha and theta activity over time also indicated a reduction in vigilance, as predicted. This occurred for all conditions, though an increase in beta activity for the full conversation group suggests that the concurrent conversation did allow those drivers to maintain some level of alertness. We conclude that the physiological data suggest that a concurrent conversation may help drivers maintain alertness, but that the performance data suggests that gains to alertness may not result in better driving safety, given the costs for dual-task coordination.

H6

ALPHA-MEDIATED ATTENTIONAL SUPPRESSION OF IRRELEVANT VISUAL FEATURES Adam C. Snyder[1,2], John J. Foxe[1]; [1]City College of New York, [2]The Graduate Center of City University New York — Many recent studies have shown that retinotopically specific alpha-band (8-15Hz) oscillatory power increases reflect suppressed processing of irrelevant parts of the visual field in visuospatial attention. We asked if alpha plays a role in the non-spatial preparatory biasing of visual attention as well, or if it is specific to spatial attentional sets. We used visual word cues to inform 12 subjects about a task-relevant feature of an upcoming visual stimulus (S2) while we recorded electrical brain activity (EEG) from the scalp. The cue and S2 were separated by an interval during which no stimulation occurs. We examined the brain activity in this interval, which reflects internal preparatory attentional processes. Subjects were cued each trial to attend to either the color or direction of motion of an upcoming dot field stimulus, and respond if they detected that a portion of the dots differed from the majority as to the target feature (i.e., they had a different color or moved in a different direction). We used the features of color and motion, which have well-known, spatially-separated cortical processing areas, to distinguish shifts in alpha power over areas processing each feature. We found that alpha power from dorsal regions increased when motion was the irrelevant feature (i.e., color was cued), and that alpha power from ventral regions increased when color was irrelevant. This pattern of results is consistent with the role of alpha-band mechanisms in spatial attention, that is: suppression of potentially distracting information. Furthermore, feature-selectivity of alpha-band effects related to subject performance.

H7

BACKWARD MASKING OF A FIRST TARGET ATTENUATES THE P3 EVENT-RELATED POTENTIALS ELICITED BY BOTH TARGETS IN THE ATTENTIONAL BLINK Benoit Brisson[1,2], Nicolas Robitaille[2], Alexandrine Deland-Bélanger[2], Thomas Spalek[1], Vincent Di Lollo[1], Pierre Jolicoeur[2]; [1]Simon Fraser University, British Columbia, Canada, [2]Laboratoire de Neurosciences Cognitives, Université de Montréal, Québec, Canada, — Masking of the first target increases the magnitude of the attentional blink (AB: a decline in second target report accuracy at short intertarget lags) relative to when the first target is not masked. We examined the underlying causes of this effect in two experiments. In Experiment 1, a single target was presented in a rapid serial visual presentation stream. The P3 to the target was isolated by subtracting infrequent target category trials from frequent target category trials. The distractor immediately trailing the target (i.e., at lag 1) was present in the masked condition and replaced by a blank screen in the not-masked condition. Masking the target by presenting a distractor at lag 1 significantly reduced the amplitude of the target-locked P3, but had no effect on P3 latency. In Experiment 2, a second masked target was always presented three positions after the first target (i.e., at lag 3). We show that, compared to a condition in which no intervening distractor was presented, presenting a distractor at lag 1 attenuates the P3 elicited by both the first and the second target. In contrast, presenting a distractor at lag 2 had no such effect. Accuracy for both targets mirrored the masking effects on the P3 component. These results clearly link the attenuation of the target-locked P3 observed in Experiment 1 to the AB effect. Implications for extent models of the AB are discussed.

H8

ATTENTIONAL SENSITIZATION OF UNCONSCIOUS COGNITION: TASK SETS MODULATE SUBSEQUENT MASKED SEMANTIC PRIMING Markus Kiefer[1], Ulla Martens[1,2]; [1]University of Ulm, Germany, [2]University of Osnabrück, Germany — In classical theories of automaticity and attention, unconscious automatic processes are thought to be independent of higher-level attentional influences. However, refined theories assume that the cognitive system has to be configured in a certain way for automatic processes to occur. In our attentional sensitization model, we propose that automatic processing depends on attentional enhancement of task-congruent processing pathways: A stimulus can only elicit an automatic process if the process-relevant stimulus dimension belongs to the active attentional set. This hypothesis was tested with a modified masked semantic priming paradigm during a lexical decision task by measuring event-related potentials (ERPs): Before masked prime presentation, participants attended in an induction task either to semantic or perceptual stimulus features, which should activate a semantic and perceptual task set, respectively. Following the unconsciously presented masked prime a semantically related or unrelated target was shown, on which the lexical decision had to be performed. Semantic priming effects on the N400 ERP component (reduction of N400 amplitude), an electrophysiological index of semantic processing, were obtained when a semantic task set was immediately induced before subliminal prime presentation. In contrast, a previously induced perceptual task set abolished N400 priming. Comparable results were obtained regardless of the difficulty level and the verbal or non-verbal nature of the induction tasks. In line with the proposed attentional sensitization model, unconscious semantic processing is enhanced by a semantic and attenuated by a perceptual task set. Hence, automatic processing of unconscious stimuli is susceptible to top-down control for optimizing goal-related information processing.

H9

MODULATION OF SENSORY AND EXECUTIVE ATTENTION PROCESSING IN INDIVIDUALS WITH SCHIZOPHRENIA AND FAMILIAL HIGH RISK Sarah J. Hart[1,2], Michael Casp[2], Mary-Agnes McMahon[2], Aysenil Belger[1,2]; [1]University of North Carolina at Chapel Hill School of Medicine, [2]Duke University Medical Center — Deficits in attentional selectivity and control in schizophrenia have been described as core changes underlying global cognitive dysfunction. However, the neuroanatomical basis for these deficits has remained poorly understood. Furthermore, it is unclear whether changes in specific mechanisms engaged during voluntary attention may reflect vulnerability markers in individuals at high risk for developing schizophrenia. The goals of this study were to characterize how sensory and executive attention processes are affected in individuals with schizophrenia (SCZ) and with familial high risk (FHR). We used functional MRI to test these mechanisms of voluntary attention in 12 participants with schizophrenia, 18 participants with FHR for schizophrenia, and 13 controls. Participants were presented with a series of green and red letters and digits matched for perceptual complexity, with the goal of identifying green letters as targets. Sensory attention processes were measured during early selection of stimuli with the task-relevant color, and executive attention processes were measured during stimuli with the targeted category. We found that during sensory attention processing, both the groups with SCZ and FHR showed hyperactivation relative to controls in the prefrontal, parietal, and occipital cortices. During executive attention processes, the SCZ group showed decreased activation relative to controls in the insula, parahippocampal gyrus, and prefrontal, parietal, and anterior cingulate cortices. The FHR group, in contrast, showed no significant differences from controls. The results suggest that sensory attention changes may reflect a vulnerability marker associated with familial risk for schizophrenia, while modulation of executive attention may be more related to disease state.

H11

SURPRISE! EARLY VISUAL NOVELTY PROCESSING IS NOT MODULATED BY ATTENTION Elise Tarbi[1], Xue Sun[1], Phillip J. Holcomb[2], Kirk R. Daffner[1]; [1]Division of Cognitive and Behavioral Neurology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, [2]Tufts University, Medford, MA — We have proposed a model of visual novelty processing that involves several stages: relatively early detection of a mismatch between perceptually novel stimuli and stored representations (indexed by the anterior N2); voluntary allocation of resources dependent on the context in which the novel event occurs (indexed by the P3); and, when appropriate, more sustained processing of novelty (indexed by late slow wave activity). There is disagreement in the literature regarding the extent to which the early detection of visual novelty, as indexed by the anterior N2, is dependent on direction of attention. In the current study, the anterior N2 was measured in 32 young subjects under two conditions that manipulated attention. Under both conditions, subjects were presented standard, target/rare, and perceptually novel visual stimuli. Under the Attend condition, subjects responded to designated visual targets. Under the Ignore condition, subjects performed a difficult n-back task in the auditory modality while passively being exposed to the visual stimuli. We found that under the Ignore condition, the anterior N2 was much larger in response to novels than rares or standards. Of particular interest, the size of the anterior N2 to novel stimuli did not differ under the Ignore and Attend conditions. Furthermore, under the Ignore condition, the anterior N2 to visual novel stimuli was not affected by the level of difficulty of the auditory n-back task (3-back vs. 2-back). Our findings suggest that the early processing of visual novelty, as measured by the anterior N2, is not strongly modulated by direction of attention.

H12

THE NEURAL BASIS OF GREAT EXPECTATIONS AND SUBSEQUENT DISAPPOINTMENTS Sarah Mohammed[1], Nienke Hoogenboom[1], Klaus Kessler[1]; [1]Centre for Cognitive Neuroimaging, University of Glasgow, UK — Raising expectations about visual events can be beneficial when targets must be rapidly selected from distractor information. However when expectations are built-up, yet unsatisfied, they may have detrimental effects. To study target expectations, we used composite targets that could be gradually built up over time. In this way, we presented a full target (3 digits), partial targets (1 or 2 digits) or no target (0 digits). Expectations for the full target were incrementally built as digits were consecutively unveiled within the RSVP stream. In several behavioural experiments we found that the partial target of 2 digits had a strong detrimental effect on detection of a subsequent target. We suggest that built-up but unsatisfied target expectations interfered with processing of downstream targets. In a follow-up MEG experiment, we employed the composite target task to investigate the neural dynamics of these expectations. Group ERPs (n=15) reveal a temporo-parieto-frontal P300 to each incoming digit. Preliminary TFR analysis suggests modulations in the 8-12 Hz range, with distinct topographic patterns with no target (0 digits), partial targets (1 and 2 digits) and the full target (3 digits). Behaviourally, we have shown that incrementally raising expectations about a target event strongly influenced the processing of subsequent targets. The greatest consequence for these downstream targets (i.e., attenuated performance) was revealed in the condition with the highest but unfulfilled target expectations (with 2 digits). Thus, expectations seem to play an essential role in visual selective attention and our MEG results reveal their neurodynamic basis.

H13

REDUCED ATTENTIONAL CONTROL IN HUMANS EXPRESSING THE GENE FOR A SUB-CAPACITY VERSION OF THE CHOLINE TRANSPORTER Elise Demeter[1], Surya Sabhapathy[1], Randy Blakely[2], Martin Sarter[1], Cindy Lustig[1]; [1]University of Michigan, [2]Vanderbilt University — Everyone has experienced mind wandering and inattention, but individuals differ in their ability to control this tendency. The University of Michigan Cognitive Genetics program was established to investigate whether genetic variation in the choline transporter (CHT) contributes to differences in attentional control. The capacity of the cortical cholinergic system in mediating attention is determined by the uptake rate of choline into cholinergic neurons by CHT. DNA from 164 participants was genotyped for a non-synonymous single nucleotide polymorphism of CHT (Ile89Val; Okuda et al., 2002). We identified 19 subjects heterozygous for the I89V variant. Choline uptake assays in mammalian cells expressing this variant show a 40-50% decrease in CHT's uptake capacity. We predicted I89V individuals would show impairments in attentional control and an increased susceptibility to distraction. Participants completed a battery of self-report measures designed to assess inattention, distractibility, and related constructs, including the Short Imaginal Processes Inventory (Huba et al., 1982) and Thought Occurrence Questionnaire (Sarason et al., 1986). A subset of participants (I89V, n = 6, Ile/Ile, n = 8) completed further cognitive testing. Between-group comparisons reveal participants heterozygous for the I89V variant score significantly higher on measures of distractibility and display differences in alerting compared to Ile/Ile participants. The reduced uptake capacity of the I89V CHTs may thus contribute to a physiological inability to maintain elevated levels of cholinergic transmission. The cognitive consequences of this limitation may manifest themselves as impairments in the ability to stay on task and employ top-down mechanisms to combat the effects of distractors.

H14

NEURAL BASES OF HYPNOTIZABILITY ASSESSED BY A FLANKER TASK Yann Cojan[1,2], Camille Piguet[1,2], Patrik Vuilleumier[1,2]; [1]University of Geneva, [2]Centre Interfacultaire de Neurosciences — The neural bases of individual differences in sensitivity to hypnotic suggestions are unknown. Modern theories of hypnosis have proposed a role for distinct abilities in attentional control. High-susceptible subjects (highs) might have better executive function than low-susceptible ones (lows) outside the hypnotic context, and thus be more apt to focus attention (Gruzelier, 1998); or alternatively, highs might be more prone to automaticity and thus should be more sensitive to distracters. We acquired fMRI images in 30 subjects performing a flanker task in which a central colored target was surrounded by flankers with a different color which could be associated with either the same hand (congruent condition) or the other hand (incongruent condition). Flankers could contain faces or scrambled faces. Behaviorally, we found no correlation between susceptibility to hypnosis and flanker interference on reaction-times, replicating previous results outside the hypnotic context (Iani, 2006). However, we found a positive correlation between susceptibility to hypnosis and activity in the fusiform gyrus when presenting faces compared to scrambled flankers in the congruent condition, suggesting that visual distracters are processed by highs more than lows in this easy condition. Conversely, posterior parietal regions, superior frontal gyrus, and left prefrontal cortex showed a negative correlation with to hypnosis in the incongruent condition when comparing face vs scrambled stimuli suggesting that avoiding distraction by faces is more demanding when subjects are less susceptible to hypnosis in conflict situations. We conclude that susceptibility to hypnosis is depending on individual attentional filtering abilities that are measurable outside hypnosis context.

H15

VISUAL WORKING MEMORY AND ATTENTION: INSIGHTS FROM INATTENTION Nikos Gorgoraptis[1,2], Paul M. Bays[1,2], Masud Husain[1,2]; [1]Institute of Cognitive Neuroscience, University College London, UK, [2]Institute of Neurology, University College London, UK — Spatial working memory and attention are closely linked, both behaviourally and in their neural substrates (Awh & Jonides, TINS, 2001). However, the relationship between non-spatial working memory and attention is less well understood. In the present study, we investigated non-spatial, visual working memory in hemispatial neglect, classically considered a disorder of spatial attention following focal brain damage. Rather than only probing whether or not an item is stored in memory, we used a novel, more detailed approach that has been implemented successfully to examine the precision with which an item is remembered in healthy observers (Bays & Husain, Science 2008). We measured precision of memory for orientation of sequentially presented visual stimuli, all displayed at central fixation, comparing neglect patients with age-matched controls and stroke patients without inattention. Precision was lower in patients with neglect, when compared with healthy or stroke controls. In all three groups, precision was highest for a single item, but decreased with increasing sequence length. In neglect patients, resolution in memory for the first of three items was lower when compared to one item followed by a blank of matching duration, suggesting that poorer performance cannot be explained by a deficit in sustained attention. These results demonstrate a deficit of non-spatial visual working memory in individuals with spatial inattention.

Attention: Other

H16

NUMERICAL VALUE AND NUMEROSITY MODULATE DIGITS PROCESSING Ziad Safadi[1], Sharon Naparstek[2,3], Avishai Henik[2,3], William B. Lawson[1], Limor Lichtenstein-Vidne[2,3]; [1]Psychiatry and Behavioral Sciences, Howard University, Washington DC, [2]Ben-Gurion University of the Negev, Beer Sheva, Israel, [3]Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev, Beer Sheva, Israel — Objective: The current research was designed in order to study whether attention and task relevance modulate numerical processing in a Stroop-like flanker task. Method: In two experiments, normal adults were presented with a single-digit target (1, 2, 6 or 7), flanked by a distractor having two dimensions—numerosity and numerical value (following Henik et al., 1999). The flanker and target could be congruent (e.g., central 2 flanked by two 2's) incongruent close (e.g., central 2 flanked by three 3's) or incongruent far (e.g., central 2 flanked by seven 7's). In Experiment 1, subjects were asked to report the target's numerical value, while in Experiment 2, subjects were asked to perform a comparative judgment task (i.e., decide whether the target was larger than or smaller than the reference 5). In both experiments, subjects were instructed to focus their attention on the central target while ignoring the distractor flanker. Results: Only the flanker's numerical value affected performance in Experiment 1, whereas both flanker value and numerosity affected performance in Experiment 2. Conclusion: The results suggest that numerosity and numerical value differ in their automatic activation during numerical conflict tasks. Specifically, numerical value is always activated even when irrelevant to the task at hand, whereas automatic activation of numerosity is dependent upon task requirements.

H17

CONTRIBUTIONS OF THE CEREBELLUM TO SUSTAINED ATTENTION: A CTBS STUDY Carla P. Arasanz[1], William R. Staines[1], Tom A. Schweizer[2]; [1]University of Waterloo, [2]University of Toronto — Attention deficits have been reported in cerebellar patients, independent of motor function or action planning. Sustained attention is the ability to maintain focus and concentration during the presentation of repetitive, non-arousing stimuli. One classic paradigm used to assess this is the sustained attention to response task (SART). Imaging studies have reported cerebellar activation associated with fronto-parietal activity during SART, suggesting its involvement in maintaining the task goal on-line. We investigated the effects of reducing cortical excitability to the left or right posterior/lateral cerebellum using continuous theta burst stimulation (cTBS). We hypothesized that the effects of cTBS on the cerebellar cortex would increase the number of commission and omission errors during the retest condition for SART. The experiment consisted of 25 sequences of numbers 1-9 visually presented in a random order, where the task is to quickly respond to all digits except for 3. SART was performed before and after cTBS either the left or right posterior/lateral cerebellar hemisphere using separate subject groups. Analysis of the results pre/post stimulation revealed a significant increase in the number of omission errors for both left and right hemisphere groups during retest ($p < 0.05$), but no significant difference in commission errors. Thus cTBS increased lapses of attention (omission errors) but had no effect on failure of inhibitory processes (commission errors), regardless of localization. Our results suggest that the cerebellum is involved in a neural network necessary for maintaining and coordinating attentional processes.

H18

EVENT RELATED POTENTIALS TO ALCOHOL RELATED STIMULI IN COLLEGE-AGED DRINKERS AND NON-DRINKERS Barbara C. Banz[1], Deana B. Davalos[1]; [1]Colorado State University — In recent years, researchers have begun to investigate whether there are neurophysiological differences in individuals who drink heavily compared to those who do not drink. Research has shown significantly reduced P3 amplitudes in response to visual stimuli in alcoholics and their children, except when those images are alcohol-related. The purpose of the current study is to further investigate this phenomenon comparing event-related potentials (ERP) of high drinkers to non drinkers when presented, positive images, negative images and alcohol related images. Participants were categorized as a drinker or non drinker based on the Alcohol Use Disorders Identification Test (AUDIT), a self report measure of alcohol use. Preliminary group comparisons were made based on differences in amplitude and latency of the P2 and the late positive potential (LPP), a component which is believed to be more evaluative in nature. This data has shown no significant difference in the amplitude or latency of the P2, meaning initial attention is equal between groups. However, we have found LPP amplitudes to be different between drinkers and non-drinkers, suggesting there may be neurophysiological indices for binge drinking which may be useful for identifying individuals who are either at risk or currently abusing alcohol.

H19

CORTICAL ORIENTING RESPONSE TO NOVELTY IS ENHANCED IN OBSESSIVE-COMPULSIVE DISORDER Norbert Kathmann[1], Moritz Ischebeck[1], Tanja Endrass[1]; [1]Humboldt-Universitaet zu Berlin, Germany — Clinical research in obsessive-compulsive disorder (OCD) revealed various alterations in cognitive and affective processes and their brain correlates. Such deficits may serve as endophenotypes which are helpful in the search for the genetic basis of the disorder and might also be targets for new interventions. We studied novelty processing using event-related brain potentials under various conditions. Novel pictures which were task-irrelevant but had either neutral or negative affective valence were presented among frequent standards and rare targets. As expected, aversive novels elicited larger P300 amplitudes than neutral novels across groups. OCD patients had increased P300 amplitudes compared to healthy control probands after novel simuli, but not after targets. Moreover, affective valence had no effect on group differences. This pattern was confirmed in a replication study. In a further experiment, a three-stimulus auditory novelty oddball task was used. Early-onset but not late-onset patients showed increased P300 amplitudes after novel sounds. To evaluate the effect of affective context we then studied auditory novelty responses during a memory task in which in context A only neutral and in context B mixed (neutral and aversive) pictures were memorized. Here, enhanced auditory novelty P300 amplitudes were found primarily in the neutral condition. It is concluded that novel events elicit larger ERP responses in OCD patients than in controls probably indicating augmented involuntary shifts of attention to infrequent irrelevant events. This abnormally high cortical orienting response is independent from the affective significance of event or context. However, it may depend on the subtype of OCD pathology.

H20

CAN ATTENTIONAL MANIPULATION MODERATE SELF-ESTEEM AND THE CORTISOL RESPONSE? Laura Copeland[1,3], Julie Chamberlin[1], Nida Ali[1,3], Cory Cooperman[1,3], Mark Baldwin[3], Jens Pruessner[1,2]; [1]McGill Centre for Studies in Aging, [2]Douglas Mental Health Institute, [3]McGill University — Stress is part of daily life, but not all individuals respond to stressful situations in the same manner. Recent research suggests that interindividual differences in personality traits directly influences how individuals respond to challenging situations. The literature demonstrates that negative attentional bias, primarily seen in individuals with low self-esteem (SE), can be manipulated through repetitive training. Training individuals to accept rather than reject positive information elevates SE, which modulates stress responsivity such that cortisol responses to stressful situations are reduced. This project examines the cognitive mechanisms involved in stress perception by manipulating early appraisal processes through the use of an attentional training task. Participants were trained to focus on positive aspects of situations through a computerized perception task that involves attending to a smiling face amidst a matrix of frowning faces. The HPA axis was stimulated via the Trier Social Stress Test (TSST) and biological stress response was determined though cortisol measures. The current project was unable to replicate previous research findings that demonstrated the impact of antecedent-focused strategies on the late-stage consequences of stress. The training may have elevated SE, eliciting the predicted lower stress response but it may have also inadvertently primed participants to focus on facial expressions, making social evaluative aspects of the TSST a more salient stressor for participants who had completed the experimental versus control training. To circumvent the priming effect of the training, participants will complete the training several days prior to exposure to the TSST. Preliminary results are in line with past findings.

H21

PREVENTING SLIPS OF ACTION BY SLOWING TASK PACE Amanda Clark[1], Shant Alajajian[1], Daniel Smilek[1], Eric Roy[1]; [1]University of Waterloo — Errors of attention, or slips of action, are very common occurrences; perhaps you walk into a room and forget what you went there to do or maybe you fail to add sugar to your coffee because you were interrupted by a phone call. While many of these attention errors are simple nuisances, action slips can also have damaging consequences. This study was designed to induce slips of action in a well-learned task to determine if slowing the pace of task execution can reduce the frequency of attention errors. Sixty young adults (18 – 25 years) were instructed to complete a well-learned action sequence either as quickly and accurately as possible or at a fixed pace of five to seven seconds, where timing feedback was given after every trial. We induced slips of action by occasionally requiring participants to deviate from the learned routine by changing one of the movement goals in the sequence. As predicted, participants who completed the task at their own pace executed each sequence significantly faster than those who were in the fixed pace condition. Also, while both groups committed numerous slips on the task, those who completed each sequence more slowly in the fixed pace condition were significantly more accurate (44%) than those in the self paced group (21%). These results suggest that a key component to preventing action slips in daily life could be executing tasks slowly enough to allow time for making changes to well-learned action routines when circumstances warrant such adjustments.

H22

COGNITIVE MODULATION OF FRONTO-STRIATAL NETWORKS IN OBSESSIVE-COMPULSIVE DISORDER PATIENTS Martin Desseilles[1,2], Alice Muselle[3], Christel Devue[3], Virginie Sterpenich[2], Thien Thanh Dang Vu[1,3], Genevieve Albouy[1], Christina Schmitd[1], Christian Degueldre[1], Christophe Phillips[1], Marc Ansseau[3], Pierre Maquet[1,3], Sophie Schwartz[2]; [1]Cyclotron Research Centre, University of Liège, Belgium, [2]University of Geneva, Switzerland, [3]University of Liege, Belgium — The obsessive-compulsive disorder (OCD) is a frequent psychiatric condition characterized by obsessions and/or compulsions. In these patients, attentional biases play a major role in the initiation and maintenance of the symptoms. We hypothesize that attentional dysfunction in fronto-parietal network may also affect processing within fronto-striatal regions and thus contribute to both cognitive as well as affective dysfunctions in OCD patient. Here, we tested with functional MRI (fMRI) whether OCD patients show altered attentional effects on the neural filtering of irrelevant visual stimuli in visual cortices. Sixteen OCD and sixteen matched controls scanned while they performed an easy or difficult detection task at fixation, while irrelevant colored visual stimuli were presented in the periphery. Our fMRI results reveal that patients with OCD show (i) an increased filtering of irrelevant information in visual cortex, (ii) a suppression of ventromedial prefrontal/orbitofrontal cortex (vmPFC/OFC) with increasing task difficulty (high attentional load), and (iii) an increased activity in ventral striatum at baseline. These findings suggest that hyper-vigilance seen in OCD patients might result in an increased attentional filtering in visual cortex. In addition, OCD patients showed a reduction of vmPFC/OFC activity during high load, as reported after successful psychotherapy. In addition, hyper-activity in striatal regions observed at baseline in OCD was significantly modulated by attentional load. Together, these findings suggest a possible therapeutic role for cognitive training in regulating brain circuits that underlie this common psychiatric disease.

H23

SIMULATED DRIVING PERFORMANCE IN PATIENTS WITH FOCAL CEREBELLAR LESIONS Karen Kan[1], Michael Cusimano[1,2], Tom Schweizer[1,2]; [1]University of Toronto, [2]St. Michael's Hospital, Toronto — Patients with cerebellar damage have been shown to have attentional and executive impairments, but few studies have looked at this in the context of real world tasks. Driving is a cognitively complex task that requires optimal motor skills and high-level executive skills (e.g. planning, coordination, multitasking). This study examined the effects of cerebellar damage on performance in simulated driving. Eight patients with focal cerebellar lesions and eight healthy participants with valid driver's licenses were tested on a commercially available driving simulator (STISIM Drive). Participants were asked to navigate traffic while performing audio and visual divided attention tasks designed to mimic driving with distraction (e.g., talking to a passenger, scenery diversions). The cerebellar lesion group drove more cautiously, with a slower mean speed than the control group. During unprotected left turns, when drivers must make rapid decisions regarding the speed of oncoming cars, judge a safe turning distance, watch for pedestrians and monitor the traffic light colour, the cerebellar group was significantly slower than controls ($p < 0.05$). There were no differences between groups in simpler driving tasks such as turning without oncoming traffic. These results indicate that cerebellar patients are slower at responding to more attentionally demanding aspects of driving, and cannot be explained by a general motor slowing. This is consistent with previous findings in our lab showing patients with cerebellar lesions are impaired on tests of attention, multitasking and executive functions. This is the first study to shed light on the potential impact cerebellar lesions have on driving.

H24

HOW JOURNAL ARTICLES ARE READ UNDER TIME PRESSURE: SACRIFICING DEPTH FOR BREADTH Lisa Meschino[1], Grayden Solman[1], Michael G. Reynolds[2], Daniel Smilek[1]; [1]University of Waterloo, [2]Trent University — Most of the reading required at universities is task-specific and time-sensitive. We read to gain information necessary for completing a task within a specific time-frame. What is unclear is how attention is allocated during reading when there is limited time available. Our study examines how attentional strategies change when reading journal articles under differing time constraints. Participants viewed two 5-page articles from the journal, Psychological Science. Undergraduate participants were divided under four experimental conditions based on reading time: a baseline condition with unlimited reading time, as well as 10-minute, 5-minute, and 2-minute reading conditions. In all conditions, each article was followed by a comprehension test. An eye monitor tracked eye movements and recorded the location, frequency, and duration of each fixation. Two models were generated from the baseline data, demonstrating two possible strategies for reading under varying time constraints. In a linear reading model, participants read the articles from the beginning until time runs out, prioritizing early regions of the article (i.e., abstract, introduction) and sacrificing later regions (i.e., methods, results, discussion). In a linear skimming model, participants reduce their reading time per region and distribute their attention to encompass more regions of the article within the allotted time. Data for each of the 2-minute, 5-minute, and 10-minute conditions support a linear skimming model. These findings suggest people engage in linear skimming of all regions with emphasis on the initial parts of the article. Therefore, it seems that, under pressure of time, undergraduates sacrifice depth of information for breadth.

H25

INTRAMODAL ATTENTIONAL PROCESSING DURING A MONOTONOUS CAR DRIVING SIMULATION: AN EEG STUDY Manfred F. Gugler[1], Claudia Sannelli[2,3], Stefan Haufe[3], Ruth Schubert[1], Michael Schrauf[4], Wilhelm E. Kincses[4], Michael Tangermann[3], Gabriel Curio[1]; [1]Charité University Medicine, Berlin, Germany, [2]idalab GmbH, Berlin, Germany, [3]Berlin Institute of Technology, Germany, [4]Daimler AG, Sindelfingen, Germany — The present study aimed at monitoring attentional processes in an intramodal (visual) setting during a monotonous car driving simulation by means of the EEG. Two different conditions were included in the study. Condition C1 consisted in watching a grey screen on which sometimes a red light appeared. Subjects had to react to this stimulus by pressing a foot pedal. Condition C2 consisted in actively driving a simulated car by performing a lane change task additionally to the first visual task. The whole session lasted approximately three hours. The EEG results revealed a main effect of condition showing a reduced parieto-occipital alpha band activity for C2 and a main effect of reaction time with a reduced frontal alpha band activity for short reaction times. No interaction between condition and reaction time was found. Thus, for a demanding dual task with intramodal stimulus competition, a short reaction time requires the strong activation of executive frontal cortices as shown by a strong alpha desynchronisation. In contrast, a previous study (Schubert et al., 2008) involving an intermodal (auditory-visual) distribution of attention showed that fast reactions to auditory stimuli are accompanied by increased alpha oscillations over parieto-occipital cortices. Considering these results we can conclude that the relation between brain rhythms and reaction times can be interpreted only in its specific context, i.e., both (low and high) alpha states are reasonable correlates of an efficient sensory-motor coupling leading to fast reactions.

H26

ATTENTIONAL BIASES FOR CIGARETTE AND ANTI-CIGARETTE CUES IN EX-SMOKERS Kristin Iodice[1], Jane W. Couperus[1]; [1]Hampshire College — Attentional biases for cigarette-related and cigarette-aversive stimuli are often seen as a feature of cigarette addiction in current smokers. Although this saliency for cigarette-related stimuli does not appear to be permanent, it is unclear when this change occurs in ex-smokers. The current study is designed to better understand the timeline of this bias elimination and to examine how cigarette-aversive stimuli affect ex-smokers over the course of cessation by using Event-Related Potentials (ERPs) to measure attentional biases. Four groups, non-smokers, smokers, recent ex-smokers (within six months of quitting), and long term ex-smokers (nine or more months since quitting), were tested for within-group comparisons of electrophysiological brain responses to cigarette-related, cigarette-aversive, and neutral stimuli. The results found that smokers and recent ex-smokers elicited a significantly enhanced P300 (P3b) for cigarette-related and cigarette-aversive stimuli in comparison to neutral stimuli. Among long term ex-smokers, the P300 response was significantly greater in amplitude only for cigarette-aversive stimuli when compared to neutral stimuli. Non-smokers did not display any significant differences between stimulus responses. These results suggest that current smokers and recent ex-smokers have an attentional bias for cigarette-related and cigarette-aversive stimuli while long term ex-smokers only possess an attentional bias for cigarette-aversive stimuli. In comparison, non-smokers did not present any attentional biases for cigarette-related or cigarette-aversive stimuli. Interestingly, when participants were asked to give explicit ratings for each stimulus, results supported neurophysiological data by showing that cognitive attitudes toward cigarette-related and cigarette-aversive stimuli change depending on smoker status.

H27

DYNAMICS OF SPATIAL-TEMPORAL PATTERNS EEG AND VISUAL EVENT-RELATED POTENTIALS DURING OF POSTURE STABILITY IN CHILDREN WITH ADHD Alexander Trembach[1], Ekaterina Vitko[1], Galina Grishina[1], Olga Gorbatova[1]; [1]Kuban State Unuversity of Physical Education, Russia — Aims: In children with Attention Deficit/Hyperactivity Disorder (ADHD) training of standing posture by visual feedback increased of posture stability and decreased inattention and impulsivity (Trembach et al, Gate & Mental Function, 2008). The purpose investigation was to study central mechanism of correction of mental and motor function. Methods: The participants were 22 children with ADHD. Test of Variable of Attention, 3D Video motion of postural sways, posturography and EEG (4-60 Hz) recorded in the ascent on tiptoe with open eyes before and after training. In additional analyzed cognitive event-related potential (ERP): responses of preparation and inhibition during a visual Go/No-go task. Results: The training posture stability reduced the level to inattention and impulsivity. Training posture stability improved control of body in space. Motions in shoulder, articulation of hip and knee joints became synchronous, its amplitude increased from knee to shoulder joint. Spatial-temporal patterns EEG were changed after training. Power spectrum EEG was decreased in bands 4-7; 8-10 Hz in frontal and central areas and increased in occipital areas. Power spectrum EEG in bands 36-47, 48-60 Hz increased in frontal and central of areas of the cortex. Amplitude of wave P 300 in conditions Go task increased in Pz and response on No-go task (P 400) increased in Cz. Conclusion: Increasing high-frequency EEG and cognitive event-related potentials after training posture stability in areas, which control voluntary movements and attention, can be neurophysiologic mechanism of correction inattention and impulsivity in children with ADHD. Supported by Russian Foundation for Basic Research No 08-04-99034

H28

TRAINING-INDUCED PLASTICITY IN LARGE-SCALE BRAIN NETWORKS FROM THE ACQUISITION OF SKILLED SPACE FORTRESS PERFORMANCE Michelle W. Voss[1], Ruchika S. Prakash[2], Kirk I. Erickson[3], Walter Boot[4], Chandramallika Basak[1], Mark Neider[1], Monica Fabiani[1], Gabriele Gratton[1], Kramer Arthur[1]; [1]University of Illinois at Urbana-Champaign, [2]Ohio State University, [3]University of Pittsburgh, [4]Florida State University — The goal of the proposed project is an enhanced understanding of learning and transfer of complex skills. The Space Fortress (SF) game was developed by cognitive psychologists as a tool to study learning and training strategies (Donchin et al., 1989). Therefore SF provides a good platform for examining plasticity of organization and integration of interacting cognitive networks. The present study examines low-frequency (.008<.08 Hz) coherence of undirected functional networks during fMRI runs of real-time, uninterrupted SF game-play, compared to runs without game-play before and after training. Results show increased functional connectivity (Fc) in an attentional network derived from an initial seed in the Supplementary Motor Area (SMA) that was specific to runs in which SF was played. Areas of increased Fc to the SMA included the Right Angular Gyrus, the Bilateral Caudate, and the Left Superior Frontal Gyrus (Z>2.33, p<.05). Greater increases in Caudate Fc to the SMA was positively associated with learning rate. Training-induced inclusion of the hippocampus into the Default Mode Network (DMN) during game play was also positively associated with learning rate. That improved game performance was specifically associated with changes in Fc during SF suggests that functional plasticity of even large-scale neurocognitive networks is expressed with context-specificity. Yet importantly, understanding what aspects of large-scale networks change as a result of training, and individual differences wherein carries important implications for understanding fundamental mechanisms behind learning and transfer of trained abilities to novel real-world tasks such as driving, sport, or neurorehabilitation.

H29

BRIEF MINDFULNESS MEDITATION TRAINING IMPROVES MOOD AND COGNITION Fadel Zeidan[1], Suan Johnson[2], Zhanna David[2], Sasha Levons[2], Rachel Hinson[2], Bruce Diamond[3], Mark Faust[2], Paula Goolkasian[2]; [1]Wake Forest University, [2]University of North Carolina at Charlotte, [2]William Paterson University — Long term meditation training has been found to be effective at improving cognition. Specifically, researchers have found that long-term mindfulness meditation practices increases the ability to sustain attention. Unfortunately, the effects of brief mindfulness meditation training have not been fully explored on attentional processes. In this study, we examined if brief meditation training would improve mood and cognition when compared to an active control group. Participants with no prior meditation experience, participated in four sessions that involved training in either meditation training (N = 24) or listening to a book recording (N = 23). We assessed mood, mindfulness, and anxiety ratings before and after the brief interventions. We assessed the effects of brief mindfulness meditation training on cognition by implementing cognitive tasks assessing verbal fluency, complex visual tracking, and working memory. Both groups were similarly effective at improving mood. However, meditation was more effective at reducing fatigue, anxiety, and increasing mindfulness, when compared to the controls. The meditators were effective at improving complex visual processing, as well as working memory performance, in comparison to the controls. These results indicate that both meditation and listening to a book are pleasurable activities, evidenced by improvements in mood. However, only the meditation group was effective at improving visuo-spatial processing, working memory, and cognitive control. Moreover, our findings suggest that brief meditation training effectively enhanced participants' ability to sustain attention, findings found with long-term meditation practitioners. These data find that the benefits on cognition can be realized after a brief mental training regimen.

H30

ATTENTIONAL PROCESSES UNDERLYING EVENT LEARNING Marta Andreatta[1], Andreas Muhlberger[1], Marta Bainchin[2], Matthias Wieser[1], Paul Pauli[1], Alessandro Angrilli[2]; [1]University of Wuerzburg, [2]University of Padova — For survival, an organism avoids threats and seeks rewards. Prompt detections of such aversive and appetitive events need attentional resources. It has been shown that differences in the temporal sequence (event timing) between a conditioned stimulus (CS+) and an aversive unconditioned stimulus (US) leads to opposite responses. Thus, defensive responses are provoked by a CS+ preceding an aversive US (CS+/US); whereas appetitive responses are activated by a CS+ following US (US/CS+). However, the role of attentional processes in determining such opponent responses is still unknown. We investigated the electrocortical and subjective responses of 34 participants. One group of participants underwent a forward conditioning (CS+/US), the other one a backward conditioning (US/CS+) procedure. CS+ and control stimuli were flickering geometrical shapes and the US was a painful electric shock. Steady-state visual evoked potentials (ssVEP) were recorded to assess sensory and attentional processing of CS+. Independently from the temporal sequence between CS+ and US, participants rated CS+ as 'emotionally' more negative compared to a neutral control stimulus after both forward and backward conditioning. However, participants showed increased ssVEP amplitude during CS+ compared to a neutral control stimulus. Such an increase was stronger either during the last seconds of forward CS+, i.e. just before the shock or during the first seconds of backward CS+, i.e. 'just' after the shock. Therefore, visual attention seems to be allocated to aversive conditioned cues both in forward and backward conditioning, a strategy probably aimed at optimizing fast and efficient responding to danger situations.

H31

CONTINGENT CAPTURE AT FIXATION DELAYS RE-ENGAGEMENT OF ATTENTION TO PERIPHERAL TARGETS: EVIDENCE FROM HUMAN ELECTROPHYSIOLOGY Henry S. Cheang[1,2], Boutheina Jemel[1,2], Pierre Jolicoeur[2]; [1]Hôpital Rivière-des-Prairies, [2]University of Montreal — Visuospatial attention is prone to involuntary capture by distractors with characteristics that match top-down attentional settings defining visual targets (Folk & Leber, 1992). For example, visual target detection can be appreciably more difficult if a distractor sharing selection features with the target was present. Distractors at fixation also produce attentional capture; Folk and colleagues claim such capture is "nonspatial" (Folk et al., 2008). Our aim was to discern whether contingent attentional capture at fixation also impacted subsequent visuospatial attentional deployment. We report results based on the electrical brain activity of 25 participants who performed a visual task that tapped nonspatial and visuospatial attention. We used the N2pc component of the event-related potential as an index of visuospatial attentional deployment. Subjects were presented with a briefly-appearing array of four eccentrically-located coloured squares with gaps and were required to indicate via button press whether a square of a particular colour had a gap in the top side. A gapless distractor square coloured white, in a non-target colour, or in the target colour, always preceded the array at fixation. There were two main results: first, accuracy was significantly reduced only for target-coloured distractors, and second, a significant delay in N2pc onset latency occurred only on trials where target-coloured distractors were presented. The results demonstrate that contingent capture, at fixation, can produce a delay in the subsequent visuospatial attentional deployment when a distractor matches the selection feature for the peripheral target, but not for equally-salient stimuli equated for luminance, spatial location, and stimulus duration.

H32

ANTICIPATING OBJECTS IN SPACE AND TIME Janice J. Snyder[1], Anjan Chatterjee[2]; [1]University of British Columbia Okanagan, [2]University of Pennsylvania — Deploying attention in both space and time optimizes behaviour by allowing us to locate and anticipate events or objects, respectively. Directing attention to the location of an impending target or to the temporal interval when an impending target will occur confers a processing advantage as measured by decreases in reaction time and increases in accuracy. Importantly, spatial and temporal attention can act cooperatively to maximize behavioural efficiency. The linking of spatial and temporal processes raises the question of whether they are mediated by common neural structures. Although some research suggests that right and left hemisphere structures are critical for spatial and temporal attention, respectively, other research suggests that right hemisphere structures are critical for both. Twenty patients with diverse right hemisphere lesions performed a detection task in which attention was directed to either the likely (i.e., 80% valid) (i) location of the target (3? or 5? on the vertical axis from fixation) via a central symbolic cue or (ii) time that the target would appear (300 ms or 900 ms after the cue) via duration of the fixation stimulus. If spatial and temporal attention are subserved by common neural structures, then facilitation effects observed in both the spatial and temporal tasks should be impaired by critical lesions and performance patterns should be correlated. The pattern of results revealed a mild negative correlation for spatial and temporal facilitation effects. This finding suggests that our abilities to anticipate objects in space and time are likely to be mediated by different neural circuits.

Executive Processes: Development & Aging

H33

FUNCTIONAL MRI MEASUREMENT OF AGE-RELATED FAILURES OF DYNAMIC ALLOCATION OF ATTENTIONAL CONTROL Trey Hedden[1,2], Emily Shire[1], Randy Buckner[1,2,3,4]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Harvard University, [4]Howard Hughes Medical Institute — Over-activation of frontal areas in older compared to younger adults is a well-observed phenomenon in the cognitive neuroscience of aging. Multiple hypotheses have been advanced to explain this phenomenon. Parametric experimental manipulations provide additional information regarding the trajectory of age differences in functional activation across levels of task difficulty. We propose that failures to dynamically allocate attentional control across levels of task difficulty may be observed with functional magnetic resonance imaging (fMRI) and may be as important to understanding age differences in performance as the more general phenomenon of over-activation. We use a parametric manipulation of task difficulty in a global-local paradigm that involves both inhibition and shifting to examine failures of dynamic allocation of attentional control. Fifty-two younger (aged 18-27) and 63 older adults (aged 60-87) participated in the global-local task paradigm while undergoing fMRI scanning. All older adults were cognitively normal individuals with a Clinical Dementia Rating of 0. Older adults displayed a pattern of greater activation than younger adults in frontal and parietal regions associated with attentional control. However, older adults who exhibited a pattern of increasing activation as task difficulty increased also exhibited better performance than did older adults who exhibited a failure to dynamically modulate activation across task difficulty levels. These results were observed independently of participants' amyloid-beta burden as measured with Pittsburgh Compound B, suggesting that such failures of dynamic allocation of attentional control are primarily associated with the neuro-cognitive effects of normal aging.

Executive Processes: Monitoring & Inhibitory Control

H34

RELATIONSHIP OF NOGO N2/P3 AND ERN/PE ACROSS WORKING MEMORY LOAD TO AUTONOMIC CARDIAC REGULATION IN YOUNGER AND OLDER ADULTS Lesley Capuana[1], Jane Dywan[1], William Tays[1], Segalowitz Sidney[1]; [1]Brock University — Our goal was to examine the relations among behavioral, electrocortical, and autonomic indices of anterior cingulate (ACC) function as older and younger adults engaged in a response inhibition task that was made more difficult by increasing working memory load (WML) across levels. The question addressed here is whether the stimulus-locked N2/P3, usually associated with successful response inhibition in classic NoGo paradigms, is functionally equivalent to the response-locked ERN/Pe, usually associated with the commission of an error on performance monitoring tasks. Although both component complexes have been linked to ACC activation, their associations with age and with cardiovascular regulation have not been assessed within one single paradigm. We recorded these components as participants responded to an inhibitory control task in which WML consisted of 2, 4, or 6 items. As WML increased, the amplitudes of both N2/P3 and ERN/Pe diminished for both groups. Components also tended to be smaller in older relative to younger adults. However, correlations with error-rate and cardiovascular measures were found only for the error-related components. ERNs (not N2s) were reduced in size as a function of sympathetic predominance at higher WM loads in the younger group, and larger Pe's (not P3s) were related to more inhibitory control errors in the older group. Thus, it would appear that despite similar ACC activation patterns, the ERN/Pe relative to the N2/P3 have different functional significance as individuals attempt to control arousal while inhibiting responses, especially when WMLs are higher.

H36

THEY ALWAYS TOLD YOU 'DON'T SAY F*CK': SOCIAL CONTROL VERSUS SELF CONTROL Marcel Brass[1], Els Severens[1], Simone Kuehn[1], Rob Hartsuiker[1]; [1]Ghent University — In our daily life we sometimes have to prevent ourselves from saying or doing things that are socially or otherwise not acceptable. Recently, we argued that a specific part of the fronto-median wall is crucially involved in the intentional decision to stop such impulsive behaviour. We dissociated this area from fronto-lateral brain regions that are involved in environmentally-guided stopping as required in stop signal tasks. The aim of the present study was to test whether the inhibition of automatically primed taboo words would be guided by an external stopping mechanism in which the social context acts like a stop signal or by an intentional decision not to say the taboo word. External stopping should lead to activation in the fronto-lateral cortex (right inferior frontal gyrus, IFG) while intentional stopping should lead to fronto-median brain activation (dorsal anterior fronto-median cortex, dFMC). Participants were led to produce a spoonerism (exchange of phonemes in a word pair) that could either result in a taboo or a non-taboo phrase. When comparing the situation where a taboo word was implied with the situation where a non-taboo word was implied we found activation in the right IFG. This finding clearly supports the idea that the inhibition of taboo words involves brain mechanisms that are similar to those involved in externally-guided stopping. The social context seems to act like an external signal that prevents us from doing socially undesirable things. One could speculate how this finding is related to the internalization of external rules.

H37

ANXIETY AND MAOA INTERACTIONS FOR COGNITIVE CONTROL: AN ERP STUDY Aminda O'Hare[1], Omri Gillath[1], Joseph Dien[2], Melanie Canterberry[1], Dean Stetler[1]; [1]University of Kansas, [2]Center for the Advanced Study of Language — The ability to efficiently resolve conflict by inhibiting extraneous information is a crucial aspect of executive functioning. Individual differences in cognitive control and sensitivity to the environment can influence one's conflict resolution ability. The current study uses trait anxiety levels and a genetic marker for mono-amine oxidase A (MAOA), which codes for products involved in the metabolism and function of serotonin, as measures of cognitive control and sensitivity. High-density event-related potentials (ERPs) were recorded while participants completed an emotional version of the Flanker task. The N2 ERP component was focused on, because it is thought to be an index of inhibitory and impulse control (Stieben, et al., 2007). Earlier N2 latencies were found for individuals high in anxiety with the high-expression MAOA allele variation for Flanker trials preceded by neutral primes, and earlier N2 latencies were found for individuals high in anxiety with the low-expression MAOA allele variation for Flanker trials preceded by socially negative primes. These different patterns of cognitive control for high anxiety individuals in different emotional contexts fit a dual-model of anxiety (Heller, et al., 1997).

H38

A DEVELOPMENTAL FMRI STUDY OF RESPONSE INHIBITION IN PEDIATRIC BIPOLAR DISORDER AND ATTENTION DEFICIT HYPERACTIVITY DISORDER Alessandra Passarotti[1,2], John Sweeney[1], Mani Pavuluri[1,2]; [1]Center for Cognitive Medicine, University of Illinois at Chicago, [2]Institute for Juvenile Research, University of Illinois at Chicago — Pediatric bipolar disorder (PBD) and attention deficit hyperactivity disorder (ADHD) share high comorbidity rates and present overlaps in diagnosis and symptoms that may hinder intervention. Therefore it is important to better differentiate the underlying pathophysiologies at a neural and behavioral level. Poor behavioral inhibition, impulsivity and inattention are prominent executive function deficits in PBD and ADHD. We examined the neural substrate of response inhibition in PBD and ADHD relative to each other and to healthy controls (HC). Fifteen unmedicated adolescents with PBD (Type I, manic/mixed), 11 un-medicated adolescents with ADHD, and 15 HC (mean age = 13.5 years; S.D. = 3.5) were scanned during a Response Inhibition Task examining the ability to inhibit a motor response to a target when a stop cue appeared shortly after. The PBD and ADHD groups did not differ on behavioral performance, but were less accurate than the HC group. fMRI findings from a whole-brain analysis in AFNI showed that for trials requiring response inhibition, the ADHD group, relative to the PBD and HC groups, demonstrated reduced activation in both ventrolateral prefrontal cortex and dorsolateral prefrontal cortex, and increased bilateral caudate activation compared to HC. The PBD group, relative to HC, showed decreased activation in left VLPFC, at the junction of inferior and middle frontal gyri, and in right anterior cingulate cortex. The present findings revealed prefrontal dysfunction in both the ADHD and PBD groups relative to HC, although it was more extensive and accompanied by sub-cortical over activity in the ADHD group.

H39

THE PREFRONTAL MECHANISM UNDERLYING INHIBITORY CONTROL: MONITORING OR STOPPING? Christopher Chatham[1], Tim Curran[1], Marie Banich[1], Albert Kim[1], Yuko Munakata[1]; [1]University of Colorado, Boulder — Inhibitory control is widely thought to rely on the functioning of the prefrontal cortex and of the right inferior frontal gyrus (rIFG) in particular. Many theories emphasize the role of these regions in stopping per se, but inhibitory control also requires monitoring for task-relevant stimuli. This raises the possibility that the rIFG does not actually implement a stopping process, and may therefore not be specific to inhibitory control. To test this possibility, we used fMRI and EEG to compare the stop signal task to an oddball task using nearly identical stimuli. Both tasks required monitoring but only the former required stopping. Our hybrid fMRI design reveals that the transient prefrontal recruitment observed in the stop task is completely overlapping with that observed in the oddball task (including in the rIFG), suggesting that the prefrontal mechanism involved in inhibitory control may reflect the monitoring demands common to both tasks. Likewise, analyses of sustained task-related activity demonstrate complete overlap between the tasks in the rIFG, a result that is consistent with a tonically-active monitoring process in the rIFG. Finally, our ERP results show that the fine-grained temporal profiles of prefrontal activity are highly correlated across tasks, indicating that the same temporal dynamics of prefrontal activity underlie these tasks despite their different demands on stopping processes, but consistent with their common demands on monitoring processes. We conclude that the prefrontal mechanisms involved in inhibitory control may subserve a monitoring role, and thus be more domain general than previously thought.

H40

IMPAIRED ERROR AWARENESS IN ABSTINENT DRUG ABUSERS CAN BE RESCUED BY THE USE OF EMOTIONALLY VALENCED STIMULI Kristen Morie[1,2], Ryan Bell[1,2], Emma Jane Forde[2], Pierfillipo DeSanctis[1,2], Hugh Garavan[2,3], John J. Foxe[1,2,3]; [1]Program in Cognitive Neuroscience, City University of New York, [2]The Cognitive Neurophysiology Laboratory, Nathan S. Kline Institute for Psychiatric Research, [3]Trinity College Institute of Neuroscience, Dublin, Ireland — We examined differences in cognitive control between abstinent cocaine and heroin abusers (N=20) and healthy age- and education-matched controls (N=20), using high-density event-related potentials. Our aim was to assess whether increasing emotional salience of stimuli to be acted upon might ameliorate performance decrements typically seen in this population. The main dependent measures were the Error Related Negativity (ERN) and Error Positivity (Pe). The ERN occurs when there is a cognitive mismatch between predicted outcomes and the actual outcome. The Pe is a sensitive measure of subsequent error awareness. Participants responded with a button push to a series of picture presentations, but were required to withhold their response for occasional repeated stimuli. Using only neutral non-valenced stimuli (from the IAPS stimulus set), abstinent abusers made significantly more commission errors than controls. The ERN to these errors did not differ between groups but in stark contrast, the Pe was almost completely absent in drug abusers. We then repeated the experiment, this time using repetitions of stimuli drawn from a set of emotionally-valenced stimuli from the IAPS set. Using these considerably more salient pictures, the Pe difference between groups was fully corrected. Combined, the results suggest that cocaine and heroin abuse may be more closely related to impaired awareness of errors rather than a weak cognitive mismatch signal. Increasing the salience of stimuli may help correct this behavior.

H41

DEVELOPMENT OF MEDIAL FRONTAL ACTIVATION DURING PERFORMANCE-MONITORING: A FMRI STUDY OF SINGLE SUBJECT ACTIVATIONS Suzanne Perkins[1], Emily Stern[1], Welsh Robert[1], Taylor Stephan[1], Fitzgerald Kate[1]; [1]University of Michigan — The medial frontal cortex (MFC) is often divided into functional zones, with more cognitive processes in the posterior region and social-emotional processes more common in the anterior extent. Differential engagement of these functional zones during performance monitoring may occur during development. The Multi-Source Interference Task (MSIT) was used to test for individual differences in these zones during error and interference. Method – The sample consisted of 23 children ages 8-17 and 21 adults ages 23-51. An event-related fMRI version of the MSIT was used to examine to distinguish error (minus correct) and interference (high minus low) processing. Individual peaks from a large area of comprising posterior and anterior zones of medial prefrontal cortex (coordinate bounds: x = -18 to +18, y = 1 to 71, z = -18 to 72) were recorded. A topograhic analysis of the distribution of activation peaks was performed (Stern et al, 2009). Results - Error Activations in both Youth and Adults spanned the both the posterior and the anterior zones of the MFC During interference, youth activate more anterior regions and adults activated more posterior regions of the MFC, ? (1, n = 164) = 28.471, p = .000, although the standard, voxel-wise group conference failed to show group differences. Conclusion – Topographic analysis of individual activation maps can show group differences where voxel-wise group averages do not. Here, the analysis showed that developmental differences in the location of MFC activation may exist during interference, possibly because cognitive monitoring regions have not matured in youth.

H42

ERROR-RELATED BRAIN ACTIVITY IN UNAFFECTED SIBLINGS OF CHILDREN WITH OBSESSIVE-COMPULSIVE DISORDER Melisa Carrasco[1], Christina LaRosa[2], Christina Hong[3], William Gehring[4], Gregory Hanna[4]; [1]University of Michigan Neuroscience Graduate Program, [2]Wayne State University School of Medicine, [3]University of Michigan College of Literature, Science, and the Arts, [4]University of Michigan — Abnormalities in the anterior cingulate cortex (ACC) have been reported in studies of obsessive-compulsive disorder (OCD). The error-related negativity (ERN/Ne) is an ACC-generated component of the event-related potential, and is also an established neurobiological index of performance monitoring. The ERN has been found to be increased in both adults and children with OCD. The purpose of this study was to assess the ERN and the error positivity (Pe) and their behavioral correlates in OCD probands and their unaffected siblings performing an Eriksen flanker task. The dataset will consist of 25 probands with a lifetime diagnosis of OCD, 25 unaffected siblings of the OCD probands, and 25 healthy controls ages 8 - 17. OCD proband diagnosis has been established using two semi-structured diagnostic interviews. In addition, all subjects have been assessed with parent-report and youth self-report questionnaires. Preliminary analyses of 18 OCD probands, 12 siblings, and 24 controls showed enhanced ERN and Pe amplitudes in OCD. ERN amplitude had significant correlations with age and obsessive-compulsive (OC) symptom ratings in all subjects and with OC symptom onset age in the OCD subjects. Pe amplitude had significant correlations with OC and other internalizing symptom ratings in all subjects. Results provide further support for a relationship between OC symptoms and exaggerated medial-frontal error processing.

H43

ERROR-PROCESSING AND TASK-RELATED FUNCTIONAL CONNECTIVITY IN SCHIZOPHRENIA Karla E. Becerril[1], Grega Repovs[1,2], Deanna M. Barch[1]; [1]Washington University in St. Louis, [2]University of Ljubljana — Individuals with schizophrenia demonstrate reduced anterior cingulate cortex (ACC) responses to error-commission. However, whether other regions known to demonstrate robust error-related activity in healthy controls also show abnormal activity in schizophrenia is less clear. In this study 37 Individuals with schizophrenia and 32 matched healthy controls performed a non-verbal 2-back working memory task while being scanned. We selected regions previously reported to demonstrate reliable error-related activation as a priori ROIs. fMRI data was first analyzed using a General Linear Model (GLM) estimating brain activity for correct and incorrect trials making no assumptions about the response shape. ANOVAs using accuracy (correct, incorrect) and timepoint within trial (frames 1-7) as a within-subject factor and group as between-subject factor revealed small regions in the ACC, bilateral insula, left anterior prefrontal cortex and left cerebellum showed a significant effect of accuracy that interacted with time, but not with group. However, larger and additional regions in all ROIs demonstrated abnormal error-related activity in the schizophrenia group. In addition, we examined whether our ROIs integrated into functional networks during task performance in the same way in healthy controls and individuals with schizophrenia. We found evidence of reduced connectivity in a prefrontal-thalamo-cerebellar loop in the schizophrenia compared to the control group. Our results suggest abnormalities in brain responses to errors among individuals with schizophrenia extend beyond the dorsal ACC to almost all of the regions involved in error-related processing in healthy individuals. Further, alterations in fronto-thalamo-cerebellar connectivity may contribute to abnormalities in responses to errors in schizophrenia.

H44

LEARNING FROM ERRORS: FEEDBACK-RELATED NEGATIVITY AND P300 IN PROCESSING NEGATIVE FEEDBACK AND ENCODING CORRECT INFORMATION Ellen de Bruijn[1], Rogier Mars[2], Richard Ridderinkhof[3], Robert Hester[4]; [1]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands, [2]University of Oxford, United Kingdom, [3]University of Amsterdam, the Netherlands, [4]The University of Melbourne, Australia — A recent fMRI study has demonstrated the involvement of posterior medial frontal cortex (pMFC) in learning from errors in an associative learning task (Hester et al., 2007). The paradigm used in that study presented feedback information along with the correct answer and did thus not allow for a dissociation between negative feedback processing and encoding of the correct information. The aim of the current study was to disentangle these processes by making use of event-related potentials (ERPs). The feedback-related negativity (FRN) is an ERP component elicited by negative feedback originating from pMFC. Eighteen subjects performed an associative learning task in which participants had to recall the spatial locations of 2-digit targets and were provided with immediate feedback regarding accuracy. After a short delay the correct answer was also provided. This short delay allowed us to disentangle the ERP components associated with negative feedback processing (FRN) and encoding the correct information (P300). Incorrect trials that were responded to correctly upon the next presentation were compared to errors that were responded to incorrectly again. The results showed that FRN amplitude was increased for negative feedback following incorrect trials that were subsequently corrected compared to trials that remained incorrect. Interestingly, the P300 in response to the presentation of the correct answer did not differ between these two conditions. The present study provides further support for the role of pMFC in learning from errors and demonstrates that processing of negative feedback is directly related to later encoding processes.

H45

EXAMINING THE NEURAL TIME COURSE OF CONFLICT ADAPTATION DURING RULE-SWITCHING Matthew Waxer[1], J. Bruce Morton[1]; [1]University of Western Ontario — A central aspect of cognitive control is the ability to flexibly adjust one's performance in light of changing contextual circumstances. For example, the behavioral cost of conflict is reduced following high- relative to low-conflict trials. This "conflict adaptation" effect is thought to be subserved by anterior cingulate cortex (ACC) activity on high conflict trials which signals the need for increased cognitive control. The conflict adaptation effect has been documented across a number of diverse tasks; however it is unclear whether conflict-driven control mechanisms operate in a domain-general or domain-specific manner. To investigate this question high-density event-related potentials (ERPs) were collected while adult (n = 20) participants performed a deductive rule-switching task in which task-switching was orthogonally crossed with conflict processing. Participants were slower on incongruent trials that were preceded by congruent trials (cI trials) than incongruent trials that were preceded by incongruent trials (iI trials). There was no interaction between switching and the conflict adaptation effect. Analysis of ERP's time-locked to stimulus presentation revealed a frontocentral N2 whose amplitude was modulated by preceding trial type. More specifically, the amplitude of the N2 was greater on cI trials than on iI trials. Distributed cortical source modeling of these data revealed increased current density activations in the vicinity of the medial prefrontal cortex and rostral anterior cingulate for cI trials relative to iI trials. Together, these data suggest that conflict-driven control mechanisms operate in a domain-general manner.

H46

HOW NORMAL WEIGHT, OVERWEIGHT, AND OBESE BRAINS WORK DIFFERENTLY: DIFFERENTIAL NEURAL RESPONSES TO FOOD STIMULI AND INHIBITION TASKS Kirk I. Erickson[1], Destiny L. Miller[1], Andrea M. Weinstein[1], John M. Jakicic[1]; [1]University of Pittsburgh — Unhealthy eating habits can affect brain morphology and function. Prior neuroimaging studies show that obese individuals respond differently to both visual and olfactory food cues than individuals within normal weight limits (Babiloni et al., 2009). In addition, previous research suggests that the compulsion to overeat in overweight and obese individuals may stem from increased brain signals in the hypothalamus and decreased inhibition during top-down modulation by prefrontal regions. Our pilot data explores the brain's role in regulating mechanisms related to healthy and unhealthy eating habits, as well as the effect of body mass index (BMI) on inhibitory processing. We hypothesize that obese individuals may exhibit a deficit in inhibitory control regulated by the prefrontal cortex (PFC). We used magnetic resonance imaging (MRI) to assess brain function in response to appetitive (i.e. images of food) and non-appetitive (i.e. images of tools) stimuli as a function of BMI. In normal (n = 9), overweight (n = 5), and obese (n = 8) individuals, we provide preliminary data to suggest that BMI modulates neural activity in response to viewing appetitive images. Specifically we found that the obese group showed increased activity in the hypothalamus and decreased activity in the PFC for appetitive stimuli when compared to individuals with a normal BMI. Using a classic test of inhibitory function, the Stroop Task, we found that individuals in the normal BMI range showed increased PFC and parietal activity during inhibition, while overweight and obese individuals failed to show the same increased activation.

H47

BRAIN ELECTRICAL RESPONSES TO MONETARY GAINS AND LOSSES ARE DIFFERENTIALLY RELATED TO WHITE MATTER MICROSTRUCTURE

Josep Marco-Pallarés[1,2], Estela Cámara[1,3], Thomas F. Münte[4], Antoni Rodríguez-Fornells[1,2,5]; [1]University of Barcelona, [2]Institut d'Investigació Biomèdica de Bellvitge, [3]University College London, [4]Otto von Guericke University, [5]Institució Catalana de Recerca i Estudis Avançats — Human behavior is guided by the desire to maximize rewards and to minimize negative events. The temporal dynamics of the brain responses to rewards and negative events have been studied using electrophysiological measures. A particularly robust finding has been the Feedback Related Negativity (FRN), an event-related brain potential peaking approximately 250-300 ms after a participant is informed about a negative outcome of an action. Besides, after a positive outcome an increase of power in the Beta/Gamma band (20-30 Hz; 250 to 400 ms) has been described. In the present investigation we address whether these two electrophysiological indices reflect different processing modes of a common system by correlating them with a measure of the microstructure of brain white matter, fractional anisotropy (FA), derived from diffusion tensor imaging (DTI) (N = 47 healthy, university students). Two distinct patterns of correlations were encountered for the loss-related FRN and gain-related Gamma increase. Significant positive correlations were found between FA and the FRN-amplitude in areas located in the ventral part of the pons and the midbrain, projecting to areas near the thalamus. In contrast a significant correlation was found between FA and gain-related Gamma increase at the right anterior cingulum bundle. The present findings suggest that individual differences in the amplitude of evoked and induced brain electrical responses are closely related to individual differences in the microstructure of white matter tracts connecting areas participating in a certain cognitive task. In addition they suggest that rewards and losses (punishments) are processed by partially distinct brain networks.

H48

DISTINCT NEURAL CORRELATES FOR MONOLINGUALS AND BILINGUALS FOR EFFICIENT COGNITIVE CONTROL

Gigi Luk[1], John Anderson[1,2], Ellen Bialystok[1,3], Fergus Craik[1,2], Cheryl Grady[1,2]; [1]Rotman Research Institute, [2]University of Toronto, [3]York University — Recent research has shown that bilinguals respond faster than monolinguals in tasks that involve cognitive control. The present study used fMRI to identify brain networks whose activity correlated with responses in a flanker task. Nine monolinguals and nine bilinguals were told to respond to the direction of a target chevron that had different flankers. The trials were baseline (no flanker), neutral (diamond flankers), congruent (same direction flankers) and incongruent (opposite direction flankers). fMRI data were analyzed using a multivariate technique (partial least squares, PLS) that is similar to a principal components analysis. Differences in response time (DRTs) for congruent and incongruent trials relative to baseline (control for motor response) and neutral trials (control for motor response and visual search) were the behavioral measures. PLS identified two patterns of activity correlated with DRTs, the first of which revealed correlations between activity and DRTs for congruent trials that applied equally to monolinguals and bilinguals. The second pattern showed regions where increased activity was correlated with smaller DRTs for congruent and incongruent trials; these regions were different in the two groups. Activity in right middle frontal gyrus, right occipital areas, bilateral superior parietal areas, left cingulate gyrus and right SMA correlated with lower DRTs in monolinguals. For bilinguals, activity in bilateral inferior frontal gyri, left middle frontal gyrus, left lingual gyrus, and left inferior temporal gyrus correlated with lower DRTs. In summary, bilinguals and monolinguals showed brain-behavior correlations involving different brain regions, suggesting unique pathways for achieving efficient cognitive control.

H49

ERROR AWARENESS: PUPIL DILATION PREDICTS ANTAGONISTIC BRAIN NETWORK DYNAMICS

Helga A. Harsay[1], Mike X. Cohen[1,3], Marcus Spaan[1], Wouter Weeda[1], Sander Nieuwenhuis[2], K. Richard Ridderinkhof[1]; [1]Amsterdam Center for the Study of Adaptive Control in Brain and Behavior, University of Amsterdam, [2]Leiden Institute for Brain and Cognition, Leiden University, [3]University of Arizona, Tucson — Although it is widely known that the anterior insula cortex plays a crucial role in error awareness, its multifaceted autonomic and brain network functions have prevented a clear distinction of its precise contributions to error awareness. Here, we used pupillometry and fMRI to clarify how error awareness arises from local- and network activity of anterior insula cortex and how both are modulated by preparatory autonomic arousal. To this end we studied errors in an antisaccade task that are not recognized as such by the participants, who evaluate their performance after each trial. Results show that individual differences in preparatory pupil diameter before an aware error predicted not only increased activation in the salience network (anterior insula cortex, rostral cingulate zone and primary somatosensory cortex) and deactivation in the default mode network, but also predicted increased functional connectivity among anterior insula cortex and other nodes within the salience network with a concurrent decrease of functional connectivity of anterior insula cortex with nodes of the default mode network. These patterns appear to reflect an autonomic foreshadow of neural readiness for salience processing and provide a mechanistic perspective on the neural networks responsible for error awareness.

H50

FNIRS AND FMRI REVEAL THE INVOLVEMENT OF FRONTAL AS WELL AS TEMPORAL REGIONS IN THE DEVELOPMENT OF AUTOMATICITY

Shaaista Bhasin[1], Gelareh Jowkar-Baniani[1], Jonathan Fugelsang[2], Kevin N. Dunbar[1]; [1]University of Toronto, [2]University of Waterloo — Despite hundreds of Behavioral, fMRI and ERP experiments, as well as computational models of the nature of automatic and controlled processes in the Stroop task, there remains considerable controversy as to the sources of interference and its underlying neural mechanisms. Using either a manual or vocal response we used fMRI and fNIRS to investigate the development of automaticity in a color/shape analog of the Stroop task. Participants received training over 0, 9, or 16 days of practice at associating a particular shape with a color. On each day participants received approximately 950 training trials. In fNIRS, we found evidence of increased Frontopolar and Supplementary Motor activation with practice. However, an interesting finding was the lack of change in activation in the DLPFC in fNIRS (vocal task), whereas significant changes in this region were observed in fMRI (manual task). Surprisingly, in fNIRS, we found opposing activation patterns for the left Temporapolar cortex with practice, where activation increased in shape naming and decreased in ink naming. Also, activation in left Broca's area decreased under both conditions, but more so for shape naming. Overall, unlike the fMRI findings, the fNIRS results show involvement of Temporal regions suggesting alternative neural mechanisms of activation in the Stroop task.

H51

THE AMPLITUDE OF THE ERROR-RELATED NEGATIVITY DEPENDS ON THE SPECIFIC COMBINATION OF EFFECTORS USED TO ELICIT IT: TOWARD A NEW PERSPECTIVE ON THE FUNCTIONAL SIGNIFICANCE OF THE ERN Eldad Hochman[1], Joseph Orr[1], William Gehring[1]; [1]University of Michigan — Here we provide evidence that the error-related negativity (ERN) is sensitive to the specific combination of response features required to produce the error response and those required to produce the correct (correction) response. Right-handed participants performed versions of two-choice flanker task in which differing finger-pair combinations were assigned to the two response keys. Condition 1: Participants performed blocks of left vs. right index, left index vs. left middle and right index vs. right middle. Condition 2: Participants performed blocks of right index vs. right middle and blocks where the right index either remained in place or moved between two keys. The ERN was larger for hand errors (and bigger for right vs. left hand) than for finger errors (and bigger for index vs. middle), which showed a larger ERN than movement errors. Thus, the ERN varied with the amount of response activation common to the error and correct(ion) response. Only early Pe, however, was sensitive to whether the index finger remained in place to tap a key vs. moved to a different key. Findings were not due to response repetition. In their current form, mismatch theories of the ERN do not predict asymmetries in which, when one member of a pair produces the error, the ERN is larger then when it produces the correct(ion) response. Although the theories could be amended, we suggest an alternative: that the ERN represents a process that inhibits or replaces those movement features that are not shared with (i.e., that interfere with) the opposing response.

H52

STROOP AND STOP-SIGNAL MEASURES OF INHIBITION: WHAT IS BEING MEASURED? AN FMRI INVESTIGATION WITH ADULTS EXHIBITING HIGH AND LOW BELIEF-BIAS IN DEDUCTIVE REASONING Kiat Hui Khng[1], Kerry Lee[1], Steven Graham[2]; [1]National Institute of Education, Nanyang Technological University, [2]National University of Singapore — There has been considerable debate regarding what is actually captured in behavioral measures of cognitive tasks such as the widely used Stroop and stop-signal paradigms. Behavioral evidence has provided conflicting evidence regarding whether similar or distinct processes underlie inhibition in the two tasks. The present study examined whether inhibition in the Stroop and stop-signal tasks is achieved by common neural mechanisms or overlapping networks activated in different ways. Functional relationship between inhibition in the two tasks and behavioral performance measures will also be examined. Behavioral and functional data were collected from 26 adults performing the Stroop and stop-signal tasks. Participants were pre-grouped into High- and Low-belief-bias groups based on their susceptibility to interference from prior knowledge in a syllogistic reasoning task. A 2 (Group: High- vs. Low-belief-bias) × 2 (Task: Stroop vs. Stop-signal) × 2 (Trial-type: Inhibitory vs. Non-inhibitory) mixed rapid event design was used. Functional data were analyzed using General Linear Model (GLM) random effects analysis (RFX). Data analysis was in progress at the point of abstract submission. Preliminary results indicate both common and unique regions related to inhibition in the Stroop and stop-signal tasks, as well as areas differentially activated by High- and Low-belief-bias groups. Planned correlation analyses between behavioral measures and functional activation in identified regions will provide some insight on the debate regarding what conventional behavioral measures of tasks like the Stroop and stop-signal are capturing.

H53

COMT GENOTYPE MODULATES THE RELATION OF ANTERIOR CINGULATE ACTIVATION TO TRAIT IMPULSITVITY AND AGGRESSION Zarrar Shehzad[1], Yoona Kang[1], Colin DeYoung[2], Elena Grigorenko[1], Jeremy Gray[1]; [1]Yale University, [2]University of Minnesota — Converging evidence suggests a modulatory function of dopamine-related genetic variation on cognitive control. The catechol-O-methyltransferase (COMT) gene has been found to influence prefrontal dopamine levels and cognitive functioning (Egan et al., 2001). Deficits in cognitive control are often observed in people with high levels of impulsivity and aggression, or "externalizing behavior" (EB; Andersson & Sommerfelt 2001), and this relation appears to depend on dopamine-related function (DeYoung et al. 2006). In the present study, we tested whether the effect of COMT on brain activity depends on EB – i.e., a modulatory effect of variations in COMT Val158 Met genotype on the relation between EB and cognitive control. In 98 male participants, we examined neural activity during a Stroop-like task (MSIT; Bush & Shin 2006) as a function of COMT and EB. Using fMRI, we measured brain activation while they performed trials imposing high or low demands on cognitive control (incongruent or congruent trials, respectively). As expected, incongruent trials activated regions of the cingulo-frontal-parietal cognitive/attention network more strongly than congruent trials. Within ACC, such activation depended conjointly on EB and COMT: stronger activation in ACC was found with higher levels of EB, but only for subjects with the Val allele. In contrast, there was no significant relation between EB and ACC activity for the other two genotypes. This suggests that absence of Met allele lowers efficiency in inhibitory control thus requiring greater recruitment of ACC. We plan to further explore this interaction using other dopamine-related genes, and a working memory task.

H54

TIME COURSE ANALYSIS OF STROOP INTERFERENCE: AN ERP STUDY Emily Coderre[1], Kathy Conklin[1], Walter van Heuven[1]; [1]University of Nottingham — The time course of the Stroop interference effect was investigated by varying the stimulus onset asynchrony (SOA) of colour and word stimuli while recording concurrent high-density event-related potentials (ERPs). Three SOAs were used: -400, in which the word appeared 400ms before the colour; +400, in which the word appeared 400ms after the colour; and zero, in which both appeared simultaneously. Behaviourally, the greatest amount of Stroop inhibition occurred at zero, with a lesser, but still significant, amount at -400ms, and no significant inhibition at +400ms. The zero SOA showed an increased negativity in the incongruent condition from 350-500ms over left centro-parietal electrodes. This incongruent negativity component may reflect conflict resolution in the incongruent condition. Comparisons of the difference waves in the zero and -400 SOAs indicate a significantly earlier and larger incongruent negativity peak in -400 compared to zero SOA. A later parietal positivity in the incongruent condition (late positive component; LPC) from 600-900ms was also found in the zero SOA; this may reflect semantic processing of words following response conflict. In the -400 SOA, this component is shifted forward, beginning 400ms after colour onset. Interestingly, an apparent discrepancy exists between ERP and behavioural data: the -400 SOA shows an earlier and stronger negative peak in the difference waves, but less behavioural inhibition, compared to zero SOA. This suggests that pre-exposure to an irrelevant word in the -400 SOA leads to earlier and more effective conflict resolution, as reflected by the earlier negative peak, which leads to less behavioural interference.

H55

EXECUTIVE FUNCTION DEFICITS IN DEPRESSION: GENERAL OR TASK-SPECIFIC? Wei-Ming Huang[1], Li Jingling[1], Kuan-Pin Su[1,2]; [1]Graduate Institute of Neural and Cognitive Sciences, China Medical University, Taichung, Taiwan, [2]China Medical University Hospital, Taichung, Taiwan — Patients with depression have been found to have impaired functions of controlling and inhibition in performing executive function tasks, as revealed in

Stroop tasks. However, it is not clear whether this deficit could apply to other tasks or are task-dependent. In this study, other tasks that also require cognitive control or inhibition were tested. If deficits in depression are general, patients should perform worse in all tasks. Twenty-one patients fulfilling DSM-IV criteria for depression and forty healthy control participants were enrolled in this study for three tasks, the set switching, the Stroop, and the response inhibition tasks. In set switching task, participants performed two tasks alternatively. Three indices, the mixing cost, the switching cost, and the congruency effect, were estimated. In Stroop task, participants quickly named the ink color of words. Inhibition (incongruent-neutral) and facilitation (congruent-neutral) effects were estimated. In response inhibition task, participants quickly clicked mouse to the target except for the trials with a beep sound. Stop signal response time was estimated by the sound interval for 75% correct inhibition. The results of all indices were analyzed by a MANCOVA with three covariates (age, sex, and education level). Univariate test showed a significant group effect for inhibition effect in Stroop task, and age effect for mixing cost in set switching task and the facilitation effect in Stroop task. In conclusion, our data did not support for the idea that the deficit in depression is general; rather, they performed worse only in the Stroop task.

H56

DISSOCIATING INHIBITORY CONTROL: RIGHT INFERIOR FRONTAL GYRUS IS NECESSARY FOR INTERFERENCE SUPPRESSION IN THE ERIKSEN FLANKER BUT NOT THE STROOP TASK Maiya Geddes[1], Ami Tsuchida[1], Mandana Modirrousta[2], Weidong Cai[3], Adam Aron[3], Lesley Fellows[1]; [1]McGill University, Montreal, [2]University of Manitoba, Winnipeg, [3]University of California, San Diego — We evaluated the generality of the role played by right inferior frontal gyrus (RIFG) in inhibitory control. Converging evidence suggests that motor response inhibition, such as that required in the stop-signal task, relies on a 'stopping network' that includes RIFG. Here we asked whether the putative role for RIFG in response inhibition extends to inhibition of inappropriate responses in two widely used tasks requiring interference suppression. Four patients with focal RIFG damage and seven demographically-matched healthy subjects performed the Eriksen flanker and Stroop tasks. The degree of slowing on incongruent versus congruent trials (i.e. Stroop and flanker effects) were the measures of interest. The flanker effect was inflated in RIFG patients ($p = 0.03$), while the Stroop effect was not ($p = 0.97$). Intact RIFG is necessary for optimal selection between competing response options in the flanker task, arguing for a role for this region in inhibitory control that goes beyond simple 'stopping'. However, damage to the RIFG does not affect interference suppression in the Stroop task. While the Stroop and flanker tasks differ in several ways, perhaps the most obvious is in their verbal and spatial content, respectively. These findings indicate that the Stroop and flanker tasks probe different aspects of inhibitory control, with intact RIFG critical only for the latter. Prefrontally-mediated interference suppression may be domain-specific, at least across verbal and non-verbal domains.

H57

FEEDBACK PROCESSING DURING RISKY DECISION-MAKING IN BORDERLINE PERSONALITY DISORDER Beate Schuermann[1], Norbert Kathmann[1], Sonia Kessler-Scheil[1], Babette Renneberg[2], Christian Stiglmayr[2], Tanja Endrass[1]; [1]Humboldt-University, Berlin, [2]Free University, Berlin — Borderline Personality Disorder (BPD) is characterized by altered risk-taking and feedback processing that involve fronto-medial brain functions. Neuroimaging studies in BPD support the notion that brain regions involved in reinforcement processing are impaired. Consequently, it is suggested that BPD patients have deficits in the integration of reinforcement signals when choosing between risky options. Nevertheless, the number of studies investigating decision-making impairments is still small and there has been little evidence of altered reinforcement processing in BPD. Thus, the present study aimed to investigate whether decision-making deficits in BPD are due to deficits in feedback processing. A probabilistic two-choice gambling task was conducted to address decision-making in BPD and matched healthy controls. Participants had to choose repeatedly between two options which differed in expected risk (high vs. low) while expected values were identical. Simultaneously, event-related brain potentials (ERPs) were recorded to examine the feedback-related negativity (FRN) and the P300. The FRN is a neural correlate of cognitive feedback processing, while the P300 represents a later top-down controlled process of affective feedback evaluation. Behavioral results suggest that BPD patients showed more risky choices than did the healthy controls. ERP data reveal that FRN amplitudes in BPD were diminished compared to healthy controls, which might reflect reduced performance monitoring and ACC dysfunctions in BPD. Further, BPD patients had increased P300 amplitudes following negative feedback, indicating that negative events were associated with higher motivational significance in BPD. In sum, results suggest deficits in decision-making in BPD which might be caused by altered feedback processing.

H58

HEMODYNAMIC CORRELATES OF FEEDBACK-BASED LEARNING IN OBSESSIVE-COMPULSIVE DISORDER Christian Kaufmann[1], Tanja Endrass[1], Rosa Gruetzmann[1], Katja Zschenderlein[1], Anja Riesel[1], Jan-Carl Beucke[2], Norbert Kathmann[1]; [1]Humboldt-Universität zu Berlin, Clinical Psychology, [2]Massachusetts General Hospital/Harvard Medical School — Obsessive-compulsive disorder (OCD) is associated with overactive performance monitoring and dysfunctional cortico-striato-thalamo-cortical paths on the neural level. Behaviourally, the disease is characterized by higher sensitivity to avoid punishment and, persumably, better implicit avoidance learning. The aim of the present study was to elucidate neural correlates of feedback-based learning in OCD: So far, 14 patients with OCD and just as many healthy controls performed a probabilistic selection task while BOLD activity was measured. The two alternative forced choice learning task allowed us to determine how decision making is influenced by past positive and negative learning experience. Although both groups achieved comparable learning performance the patient group showed significantly more negative learning behavior compared to the control group, i. e. patients with OCD were more susceptible to negative feedback. Feedback-locked analysis of hemodynamic signals revealed that the task activated mainly ventral as well as dorsal striatal regions, medial orbitofrontal, and cingulate regions. Negative feedback activated the globus pallidus more in patients than controls while there was no effect for positive feedback between groups. These data indicate that patients with OCD show altered processing of negative feedback linked to a key structure of the basal ganglia which usually relays information from the putamen and the caudate nuceleus to the thalamus. Therefore the patient's superior implicit avoidance learning might be associated with overactive basal ganglia activity.

H59

HOW WRONG WAS I?: THE IMPACT OF CORRECTIVE INFORMATION ON ELECTROPHYSIOLOGICAL CORRELATES OF ERROR PROCESSING Jeffrey Cockburn[1], Clay Holroyd[2], Michael Frank[1]; [1]Brown University, [2]University of Victoria — The error-related negativity (ERN) is a component of the event-related brain potential that occurs following negative feedback (fERN) and erroneous responses (rERN). Recent theories have associated the ERN with a prediction error signaled by the midbrain dopamine system. Within this framework, the fERN is an index of the discrepancy between the predicted and actual outcome of an action. However, it is not clear how targets of the prediction error use this signal to improve future performance, and in turn, how target system activity gives rise to the fERN. To investigate this question, we examined the fERN with respect to the amount of corrective information encoded in the feedback stimulus. Participants performed a time estimation task in which they estimated the duration of one second. Each participant experienced four different types of feedback stimuli, each with a varying degree of corrective information. Correct feedback was identical in all conditions, while incorrect feedback consisted of: 1) A binary condition indicating incorrect only, 2) a direction condition indicating too fast or too slow, 3) a magnitude condition indicating error size, and 4) a combined condition in which both error magnitude and direction were provided. Our results show that the fERN is sensitive to the amount of corrective information supplied in response to an action, decreasing in size with increasing information. We provide a model-based explanation of these results building upon previous models of the fERN.

Thinking: Reasoning

H60

EMOTIONAL CONTENT SHIFTS ACTIVATION TO VENTROMEDIAL PREFRONTAL CORTEX DURING BELIEF BIAS SUPPRESSION IN LOGICAL REASONING Melanie Stollstorff[1], Stephanie E. Bean[1], Lindsay M. Anderson[1], William N. Parrott[1], Noah Schoenholtz[1], Adam D. Evans[1], Chandan J. Vaidya[1,2]; [1]Georgetown University, [2]Children's National Medical Center — The interplay between emotion and cognition has fueled much debate amongst philosophers, psychologists, and cognitive neuroscientists. It is possible that the brain may be able to provide insight into some of their questions. Reasoning and decision-making research is beginning to yield promising results. One well-documented bias in logical reasoning is the belief-bias effect, which occurs when one's beliefs about the world influence reasoning. Emotional content can intensify this effect. Neuroimaging studies have found that successful belief-bias suppression with non-emotional content recruits lateral prefrontal cortex (Goel&Dolan, 2003a). It has also been found that logical reasoning with emotional content recruits ventromedial prefrontal cortex (vmPFC) (Goel&Dolan, 2003b). It is unknown which brain region supports the suppression of belief-bias with emotional content. The present study used fMRI to scan healthy adults while completing a logical reasoning task (3-term relational transitive inference problems), which included congruent trials (beliefs in accordance with conclusion validity) and incongruent trials (beliefs discordant with conclusion validity) with emotional or non-emotional content. Behaviorally, significant belief-bias was found (participants were faster and more accurate for congruent than incongruent trials), and participants showed similar levels of belief-bias for emotional and non-emotional conditions. Neuroimaging results showed that bilateral vmPFC was more active for emotional than non-emotional belief-bias suppression, whereas bilateral superior frontal (BA9) and anterior cingulate gyrus was more active in the reverse comparison. Therefore, inclusion of emotional content to a reasoning task shifted activation to ventromedial prefrontal activation indicating a distinct neural substrate for bias suppression in "emotional" logical reasoning.

H61

TRAINING SOFTWARE INCREASES EARLY CHILDHOOD BRAIN DEVELOPMENT AND INTELLIGENCE Sylvain Moreno[1], Raluca Barac[1], Nicholas Cepeda[1], Glenn Schellenberg[2], Tom Chau[3], Ellen Bialystok[1,4]; [1]York University, [2]University of Toronto Mississauga, [3]Bloorview Research Institute, [4]Rotman Research Institute — This paper reports the results of a study of software designed to improve cognitive skills through music/singing training. Music expertise has been shown to improve several cognitive skills such as general intelligence. This music advantage has mainly been shown after long periods of training with professional musician population. These findings have been attributed to training requirements for musicians that involve high levels of control and memorization. The present study used a pre-test/post-test design with 60 children, 4-to 6-years old, with no previous musical or visual art (control group) training, to determine 1) whether a short period of training can improve global skills such as intelligence and more specialized skills such as grapheme-phoneme conversion and rhyming, and 2) whether a short period of training can also induce modification in brain processing. Following the first testing session, children were pseudorandomly (controlling for age, IQ score, and maternal education) assigned to computerized music or visual art training for 1 month and were tested again after training with the same tests. Here, we report the results of ERP recordings as children performed a visual Go-Nogo task. Children were also tested on reading skill (Woodcock) and intelligence (WIPPS). Children in the music training, but not the visual art training, showed an increase of N2 ERP wave related to conflict detection and response inhibition and enhanced reading abilities and verbal intelligence. These results show that one month of musical training suffices to significantly speed up development of these skills and modify brain processing in early childhood.

H62

GAINS IN FLUID INTELLIGENCE AFTER TRAINING NON-VERBAL REASONING IN 4-YEAR-OLD CHILDREN: A CONTROLLED, RANDOMIZED STUDY Sissela Bergman Nutley[1,2], Stina Söderqvist[1,2], Sara Bryde[1,2], Lisa B. Thorell[1,2], Hans Matsson[1], Myriam Peyrard-Janvid[1], Juha Kere[1,3], Keith Humphreys[1], Torkel Klingberg[1,2]; [1]Karolinska Institutet, [2]Stockholm Brain Institute, [3]University of Helsinki — Fluid intelligence (Gf) predicts performance on a wide range of cognitive activities, and children with impaired Gf often experience academic difficulties. Previous attempts to improve Gf have been hampered by poor control conditions and single outcome measures. It is thus still an open question whether Gf can be improved by training. The main aims of this study were therefore to investigate: (1) if Gf is improved through computerized training on non-verbal reasoning tasks, (2) if training working memory or non-verbal reasoning would result in any transfer to measures of the non-trained construct, Gf and working memory, respectively. This study included 101 4-year old children who performed computerized tasks 15 min per day for 25 days, of either non-verbal reasoning, working memory, a combination of both, or a placebo version of the combined training. Compared to the placebo group, the non-verbal reasoning training group improved significantly on two non-trained tests of problem solving. Smaller gains on problem solving tests were seen in the combination training group. These gains were also evident when Gf was analysed as a latent variable of several reasoning tasks. The group training working memory improved on measures of working memory, but not on problem solving tests. Molecular analyses of polymorphisms in 5 genes involved in the dopamine neurotransmitter pathway, indicated that the T allele of rs27072 in the gene coding for the dopamine transporter (DAT1/ SLC6A3), positively influenced the effect of training. This study shows that it is possible to improve Gf with training in young children.

H63

DEVELOPMENTAL TRAJECTORIES OF NUMERICAL AND NON-NUMERICAL ORDINALITY PROCESSING IN THE BRAIN: AN FMRI STUDY Stephan Vogel[1], Liane Kaufmann[2]; [1]Numerical Cognition Laboratory, University of Western Ontario, Canada, [2]University of Salzburg, Salzburg, Austria — A large body of evidence has implicated the intraparietal sulcus (IPS) in number processing. However, most studies have focused on quantity (i.e. discrete set size) rather then ordinality representaion (i.e. serial order). Recent findings from studies with adults have revealed that the anterior IPS is involved in processing both numerical and non-numerical ordered stimuli such as numbers and letters. Relatively little, however, is known how these processes change over developmental time. To further investigate the role of the anterior IPS and to identify its possible role in the development of odinality processing, we asked eleven children and eleven adults whether three horizontally presented stimuli are linearly ordered. Stimuli consisted of either a) three one-digit numerals that varied in numerical magnitude or b) artificial symbols that differed in their physical size. Participants task was to determine whether the three stimuli (numerals or artificial symbols) were arranged in linear order or not. Stimuli were presented in a pseudo-randomised block-design within a 1.5.Tesla functional Magnetic Resonance Imaging (fMRI) scanner. The analysis of functional data revealed significant main effects of group and task within the IPS. Most importantly, the left supramarginal gyrus (SMG) was significantly modulated by a group x task interaction. Parameter estimation in children yielded a stronger SMG activation in response to the non-numerical condition. In adults both tasks showed a similar activation extend. Taken together, the present data demonstrate that areas in and around the left anterior IPS undergo an ontogenetic specialization for the representation of numerical and non-numerical order.

H64

TIMELINES AND NUMBER LINES: ARE HISTORIC YEARS PROCESSED MORE LIKE NUMBERS OR EVENTS? Margaret M. Gullick[1], Elise Temple[1]; [1]Dartmouth College — While numbers generally cue processing of quantity or order, they can also contain semantic information, as in the case of historic events (e.g., "1492" calls forth associations of Columbus sailing the ocean blue). Whether these numbers are processed as quantities or events may depend on the context in which they occur. This study employed a comparison paradigm using either dates and large non-semantic numbers, or dates and historic events described in words. Participants were asked to choose the larger number (N=16 subjects), or the later (N=16) or more recent (N=16) event, of two presented comparators, creating separate Number and Event contexts. A Distance Effect was found across stimuli and conditions, while a SNARC effect, indicating a spatial understanding of order, was present only for date and number stimuli. Dates were processed consistently across conditions, and were generally similar to numbers, presenting normal Distance, Minimum, and SNARC Effects. However, word-events, while much slower, showed a normal Distance Effect, but no SNARC effect and a "Maximum effect," being faster for more recent events (thus larger numbers). No differences were found between the "later" and "more recent" event conditions. These results suggest that historic dates are automatically processed as numbers, regardless of the context. This paradigm is being extended to fMRI to investigate the relative activities of specific brain areas important for processing number (e.g., intraparietal sulcus) and semantics across stimulus types and between question contexts.

H65

A BIAS AGAINST DISCONFIRMATORY EVIDENCE (BADE) IN SCHIZOPHRENIA IS ASSOCIATED WITH REDUCED ACTIVATION IN A TASK-POSITIVE NETWORK INVOLVING THE DORSAL ANTERIOR CINGULATE CORTEX (DACC) Katie Lavigne[1,2], Jen Whitman[1,2], Paul Metzak[1,2], Patrick Carolan[3], Todd Woodward[1,2]; [1]University of British Columbia, Vancouver, Canada, [2]British Columbia Mental Health and Addictions Research Institute, Vancouver, Canada, [3]Simon Fraser University, Vancouver, Canada — A bias against disconfirmatory evidence (BADE) has been observed in schizophrenia, and may underlie the fixedness aspect of delusions. In the current study we investigated neural regions involved in the processing of disconfirmatory evidence using event-related functional magnetic resonance imaging (fMRI). Twenty healthy controls and eight schizophrenia patients performed a perceptual interpretation task in which they rated the degree to which a morphed image composed of two different animals appeared to be an image of one of the two animals. Following a delay, participants rated a second image composed of the same animals morphed at a different ratio. In the disconfirmatory evidence condition, the second image switched to primarily resembling the other animal (e.g. Image 1 - 70% seagull, 30% armadillo; Image 2 - 10% seagull, 90% armadillo). Constrained principal component analysis (CPCA) revealed two neural networks, one task-positive network involving primarily activation in the dorsal anterior cingulate cortex (dACC), and a task-negative network involving deactivation in the ventral anterior cingulate cortex (vACC). Healthy subjects showed greater activation in the dACC system relative to schizophrenia patients, but no differences emerged for the vACC system. These preliminary results suggest that the bias against disconfirmatory evidence (BADE) prevalent in schizophrenia patients may result from reduced activity in a task-positive network involving the dACC. The dACC has been implicated in the detection and resolution of cognitive conflict; therefore, a reduced ability to detect cognitive conflict may underlie the BADE observed in schizophrenia.

H66

THE ROLE OF TASK-RELATED DEACTIVATIONS IN THE COMPARISON OF COMPETING HYPOTHESES DURING A PROBABILISTIC REASONING TASK Jennifer Whitman[1], Todd Woodward[1,2]; [1]University of British Columbia, [2]Simon Fraser University — We used fMRI to investigate the brain regions involved in the comparison of competing hypotheses. On each trial of a probabilistic reasoning task, participants judged how strongly the available evidence supported a given focal hypothesis, relative to its alternative. In order to identify brain regions involved in comparing evidence for competing hypotheses, we contrasted activation during the hypothesis comparison task with activation during a closely matched evidence assessment control task. In the regions with significantly different activation during the hypothesis comparison task, we then examined how activation varied as a function of two factors relevant to hypothesis comparison. The first of these factors was whether the evidence led participants to accept or reject the focal hypothesis. The second was the difficulty of the comparison task; namely the extent to which the evidence favored one hypothesis over the other. Both factors significantly affected the task-related deactivations observed in right posterior temporal cortex (BA 37) and the left middle temporal gyrus (BA 21). In these regions, the deactivations were greater when evidence favored the alternate hypothesis than when it favored the focal hypothesis. This suggests that more neural suppression is required to reject the hypothesis one is considering than to accept it. This difference was larger when the evidence only weakly favored one hypothesis over the other than when it strongly favored one hypothesis. These results indicated that the degree of neural suppression required to reject a hypothesis increases as a function of task difficulty.

H67

COGNITIVE STYLES AND SEMANTIC RETRIEVAL OF COMMON OBJECT KNOWLEDGE David J. M. Kraemer[1], Nina S. Hsu[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania — Recent work has begun to investigate the psychological and neural underpinnings of visual and verbal cognitive styles. These styles putatively represent preferred modes of processing information, such as whether an individual prefers to think in terms of pictures or words during reasoning. Following this line of research, the present study examines how cognitive style interacts with the semantic retrieval of object knowledge. Participants completed the Verbalizer-Visualizer Questionnaire (Kirby et al., 1988), assessing their self-reported cognitive styles on two independent dimensions (visual and verbal). A separate task required participants to make two different types of similarity judgments about common objects – color or general semantic meaning. A probe word was presented with two potential target words. During color judgment trials, the correct target (e.g., pencil) matched the probe (lemon) on the color dimension. The incorrect target (apple) acted as a lure, and matched the probe on the meaning dimension. Similarly, on meaning judgment trials the correct target was related to the probe in general semantic meaning, while the incorrect target acted as a lure on the color dimension. Performance on both judgments was correlated with self-reported cognitive style. Participants who reported a preference for the verbal cognitive style were more distracted by the semantic associate lures during color judgments. Similarly, participants who reported a preference for the visual cognitive style performed worse on meaning judgments. The present results indicate that individual differences in self-reported cognitive styles are associated with differences in how individuals access semantic information about common objects.

H68

AN ELECTROENCEPHALOGRAPHY STUDY OF TWO FORMS OF REASONING Chaille Maddox[1], Karen Froud[1], John Black[1]; [1]Teachers College Columbia University — In inference-making, humans can alternate between strategies which are principally syntactic and rule-governed, and those which rely on aspects of meaning (Schwartz & Black, 1996; Gentner & Stevens, 2001; Johnson-Laird, 1983). ERP studies have shown that violations of syntactic or semantic expectancy in linguistic processing are associated with specific brain responses (P600 and N400, respectively). We used ERP to examine brain responses to rule-based and relational visual reasoning tasks, to establish whether there are similar neural signatures associated with these distinct processing modes. Participants were trained in rule-based (RB) or mental modeling (MM) reasoning strategies for visual problem solving. They viewed videos depicting dynamically rotating gears, and used the strategy to predict which way the last gear should turn. Their expectation was either met ("expected") or not ("unexpected"). High-density EEG was concurrently recorded and ERPs were derived offline by segmentation and averaging. Grandaveraged responses to expected and unexpected stimuli were compared for the RB and MM trained conditions. In the MM condition, an anterior N300-N400 complex was found, reflecting unexpectedness within image-specific representational networks (Sitnikova et al., 2006; Federmeier & Kutas, 2001; McPherson & Holcomb, 1999). In contrast to predicted P600 responses to the RB condition, we found a posterior N400/N700, a large ramp-like negativity. When present anteriorly this has been linked to syntactic expectancy for phrasal heads (Van Petten & Kutas, 1991; Brown et al., 1999). We propose for the RB task, the presence of the N400/N700 at posterior sensors reflects violation of rule expectancy with visual-spatial stimuli.

Perception & Action: Vision

H69

DISENTANGLING SENSORY INTEGRATION AND MOTOR PLANNING DURING PERCEPTUAL DECISION-MAKING Flavia Filimon[1], Niels A. Kloosterman[1], Jonathan D. Nelson[1], Marios G. Philiastides[1], Hauke R. Heekeren[1,2]; [1]Max Planck Institute for Human Development, Berlin, Germany, [2]Freie Universitaet Berlin, Germany — Perceptual decision-making lies at the interface of sensory evidence integration and motor output selection. For instance, one might decide if a stimulus is a cat or dog, and choose a particular response to indicate one's choice. Recent studies have claimed that sensorimotor regions (e.g. LIP or FEF) that guide one's response (e.g. an eye movement) also integrate the sensory evidence for the signaled perceptual decision. However, previous studies always paired perceptual categories with pre-assigned motor responses. This raises the possibility that rather than accumulating sensory evidence towards perceptual decisions, effector-dominant premotor and parietal regions are instead planning the response associated with each perceptual category. In our event-related fMRI study, we sought to disentangle response planning from perceptual decisions. Fifteen subjects viewed face and house images containing high or low sensory evidence, without knowing how they were going to indicate their decision. After a variable delay, subjects were informed of the effector (hand or eye) they were to use to indicate their choice, and of the possible target locations representing each possible decision. Only then were they able to start planning a particular response. Our results suggest that when motor planning is dissociated from the perceptual decision, parietal and frontal effector-dominant regions guiding hand or eye responses do not integrate the sensory evidence for particular decisions. This process appears to be implemented in prefrontal cortex. Area LIP shows greater activation to easy compared to difficult decisions only during the motor planning stage. This suggests differential prefrontal and parietal contributions to decision-making.

H70

ENCODING OF TEMPORAL PROBABILITIES IN THE HUMAN BRAIN Domenica Bueti[1,2], Bahador Bahrami[2], Vincent Walsh[2], Geraint Rees[2], Emiliano Macaluso[1]; [1]Neuroimaging Laboratory, Fondazione Santa Lucia, Rome, Italy, [2]Institute of Cognitive Neuroscience, University College London, UK — Anticipating the timing of future events is a necessary precursor to preparing actions and allocating resources to sensory processing. This requires elapsed time to be represented in the brain and used to predict the temporal probability of upcoming events. While neuropsychological, imaging, magnetic stimulation studies and single unit recordings implicate the role of higher parietal and motor related areas in temporal estimation, the role of earlier, purely sensory structures remains more controversial. To investigate the neural correlates of temporal expectancy in sensory cortices and other cortical structures, we ran two functional MRI (fMRI) experiments where participants were trained to anticipate the occurrence of either a visual (an annulus changing in color, experiment 1) or an auditory event (the sound of hands-clapping or of a hammer-hammering, experiment 2). In both studies we demonstrate that the temporal probability of expected visual and auditory events is encoded not by a single area but a wide network that importantly includes neuronal populations at the very earliest cortical stages of visual and auditory processing. Moreover we show that activity in those areas changes dynamically in a manner that closely accords to temporal expectations. In experiment 2 this modulatory effect included extrastriate visual areas known to process body-parts and tools, despite these were never presented visually during the experiment.

H71

HOW MANY PEOPLE ARE ABLE TO CONTROL A P300-BASED BRAIN-COMPUTER INTERFACE (BCI)? Gunther Krausz[1], Christoph Guger[1], Eric Sellers[2]; [1]G.tec Medical Engineering GmbH, Austria, [2]East Tennessee State University — An EEG based brain-computer interface (BCI) can be used to control systems such as computers, wheelchairs or virtual environments. One of the most important applications is a spelling device to aid severely disabled individuals with communication. In this study, 100 subjects tested a P300 based BCI system to spell a 5-character word with only 5 minutes of training. 8 EEG signals were acquired while the subject looked at a 36 character matrix (6x6) to spell the word WATER. Two different spelling methods were used: the RC (row-column) and the SC (single character) spelling mode. The BCI system classifier was trained on the data collected for the word WATER. During the real-time phase of the experiment, the subject spelled the word LUCAS. 72.8% (N=81) were able to spell with 100% accuracy in the RC paradigm and 55.3% (N=38) spelled with 100% accuracy in the SC paradigm. Less than 3% of the subjects did not spell any character correctly. This study shows that high spelling accuracy can be achieved with the P300 BCI system using approximately five minutes of training data for a large number of non-disabled subjects, and that the RC paradigm is superior to the SC paradigm. 89 percent of the 63 RC subjects were able to spell with accuracy 80% – 100%. A similar study using a motor imagery BCI with 99 subjects showed that only 19% of the subjects were able to achieve accuracy of 80% – 100%.

H72

LEARNING AND IDENTIFICATION OF FACIAL IMAGES WITHOUT AWARENESS Tammy Ott[1], Vanessa Vakili[1], Harry Funk[1]; [1]Smart Information Flow Technologies, Minneapolis — It is now well accepted that complex cognitive activity can be affected by events that cannot be consciously perceived or remembered. We theorize that both the learning of new information and the later identification of that information can occur without the conscious attention and awareness of an observer, thus bypassing the dual-task bottleneck. For this behavioral study, we used unconscious priming techniques to aid observers in becoming familiar with previously unseen faces while identification of these primed faces occurred through the monitoring of the observer's skin conductance response (SCR). Specifically, brief exposures of faces (with happy, angry, or neutral expression) were presented to observers engaged in a baggage screening task. Presentations followed a mere exposure (ME) or evaluative conditioning (EC) paradigm. Later both primed and unprimed faces were consciously shown to observers while evidence of information transfer was tested using physiological and behavioral measures of affect. No significant SCR effects with ME priming were found, but behavioral measures indicated that primed angry faces were liked more than unprimed angry faces. When EC was used a significant interaction between priming and expression type suggested the peak amplitude of SCRs was larger for primed angry faces compared to unprimed angry faces. Additionally, both the onset latency of SCRs and peak latency of SCRs were significantly greater for primed angry faces compared to unprimed angry faces. Overall, results demonstrate that unconscious identification of unconsciously learned faces can occur when angry facial expressions are paired with negatively arousing images in an evaluative conditioning paradigm.

H73

VISUAL AWARENESS AND ELECTROPHYSIOLOGICAL INDICES OF FACE-SPECIFIC PROCESSING DURING MOTION-INDUCED BLINDNESS Joseph A. Harris[1], David L. Barack[1], Alex R. McMahon[1], Marty G. Woldorff[1]; [1]Duke University — In motion-induced blindness (MIB), covertly attended static visual targets superimposed on a globally moving distracter array spontaneously disappear from visual awareness before perceptually reappearing. Accordingly, this effect can be used to investigate the extent of visual-object processing that occurs in the absence of visual awareness. The present study sought to extract an electrophysiological index of object-level processing -- the N170 event-related potential (ERP) component for faces relative to other objects -- that might be associated with both the physical and the perceptual (MIB-mediated) reappearance of face stimuli. If face processing is abolished during MIB, face-specific activity following MIB would be expected to mirror that associated with physical onsets. Alternatively, if face processing at all levels continues unaffected by MIB, no face-specific enhancement would be expected to occur following MIB. The results showed hallmark face-specific ERP activity in response to the perceptual reappearance of face stimuli following MIB that was very similar in distribution to that elicited by physical reappearance, although at reduced amplitude. These intermediate results suggest that face processing is only partially disrupted during MIB, or only at certain levels of the system. For example, feed-forward face-specific activity in extrastriate visual regions may continue uninterrupted during MIB, but there may be reentrant processing to the face module associated with allocation of attention to the face stimulus following re-emergence of perceptual awareness of it. The present results are consistent with behavioral data demonstrating considerable levels of visual processing during MIB, and suggest possible mechanisms for how it disrupts visual awareness.

H74

THE IMPACT OF ANIMATED ADVERTISEMENTS ON READING IN THE INTERNET Jaana Simola[1,2], Jarmo Kuisma[1], Anssi Öörni[1], Liisa Uusitalo[1], Jukka Hyönä[3]; [1]Aalto University, [2]University of Helsinki, [3]University of Turku — Animated advertisements on web pages constitute a constant change in the visual field. As human vision is sensitive to motion, animated ads in the visual periphery may disrupt on-line reading. We conducted three eye-tracking experiments with real web pages to investigate to what extent advertisements attract visual attention and affect on-line reading. In experiment 1, a horizontal ad was placed on top of a central text and a vertical ad to the right from the text. In congruous conditions, both ads were either static or animated. In incongruous conditions, the other ad was animated and the other one static. Number of fixations, fixation durations and number of regressive saccades were higher in incongruous conditions, indicating more distraction in incongruous relative to congruous conditions. Experiments 2 and 3 included an abrupt onset of the ads. Results showed a significant correlation between the ad onset time and the time when the eyes first entered the vertical ad, indicating that ads in the proximity of the text attracted attention. To test the effect of task load, the participants in experiment 3 were instructed to scan the web pages according to their own interest, whereas in experiments 1 and 2 the task was to read for comprehension. During scanning, participants entered the text area later, made longer saccades, but fewer fixations and regressions than in the reading task. In conclusion, the results suggested that animated ads attract attention and distract reading, especially when the task is to read for comprehension.

H75

AN ELECTROPHYSIOLOGICAL INVESTIGATION OF EFFECTIVE AND INEFFECTIVE MASKS IN OBJECT SUBSTITUTION MASKING Jarrod R. Dowdall[1], Matthew S. Tata[1]; [1]University of Lethbridge — Object Substitution Masking (OSM) occurs when a salient object (the mask) interferes with perception of a unique shape (the target) at the same location. This effect occurs when attention cannot be efficiently oriented through a cluttered visual scene and when appearance of the mask lags behind the target by about 180 ms. Previous studies demonstrated that attentional selection of the target prior to mask onset decreased mask effectiveness (Di Lollo, Enns & Rensink, 2000; Tata, 2002). For example, targets that "pop out" of the display are highly resistant to masking. Here we investigated the electrophysiological activity associated with effective and ineffective masks as modulated by the context in which the target appeared. Participants viewed a search array of 8 letters, either Cs or Os, arranged in a notional circle around fixation. A brief square mask, concentric with the target, appeared after an onset asynchrony (SOA) of 180 ms. Cortical responses to target and mask onsets were measured using 128-sensor electroencephalography (EEG). We found that popout and non-popout targets were differently susceptible to masking and that this perceptual difference was reflected in a series of differences in the cortical response to mask onset. The mask tended to elicit more distinct electrical activity when it was effective relative to when it was ineffective. These data suggest that masking occurs when neural representations of the mask and target overlap in time.

H76

PRESERVED ENCODING UNDER HIGH ATTENTIONAL LOAD IS SPECIFIC TO FACES: ERP EVIDENCE Markus F. Neumann[1], Tarik N. Mohamed[1], Stefan R. Schweinberger[1]; [1]University of Jena — According to recent models of selective attention, processing of task-irrelevant stimuli is abolished when attentional resources are fully consumed by task-relevant material (high load). However, task-irrelevant familiar faces can elicit repetition-related neural modulations despite high load at initial presentation (Neumann & Schweinberger, 2008). Although faces may access a face-specific attention resource, it is also possible that the processing of familiar faces requires very little general attention resources. In Experiment 1 we tested whether task-irrelevant unfamiliar faces also elicit repetition modulations under high load. Participants performed a letter identification task by indicating whether an "X" vs. "N" was among 6 different (high load) or 6 identical (low load) letters. Letter strings were superimposed on task-irrelevant faces. Following letter identification, participants detected occasional butterflies among S2 probes, which were either identical repetitions of S1 faces or new faces. ERPs revealed an occipito-temporal N250r-repetition effect to unfamiliar faces that was unaffected by load at S1 presentation. In Experiment 2 we tested whether preserved encoding under high load is specific for faces, employing hands and houses as additional categories. Body parts have been discussed to attract attention in a similar fashion as faces, and therefore appear likely candidates for preserved encoding under high load. However, while N250r-repetition effects were replicated for faces, repetition-related neural modulations were absent under high load for both houses and hands. This strongly suggests that encoding under high load is mediated by a separate face-specific attention resource, which cannot facilitate encoding of body parts or artificial objects.

H77

EFFECT OF OPPEL-KUNDT ILLUSION ON SIMPLE REACTION TIMES Silvia Savazzi[1], Barbara Emanuele[1], Paige Scalf[2], Diane Beck[2]; [1]University of Verona and Nazional Institute for Neuroscience, Italy, [2]University of Illinois, Urbana-Champaign and Beckman Institute — The Oppel-Kundt Illusion (OKI) consists of the perception of a filled space as larger than an empty space of the same size. Here, we used a modified version of that illusion composed of a gradient of vertical lines whose spacing decreased progressively from one side to the other: space is expected to be perceived as larger where the lines are more compressed. In this experiment we tested the hypothesis that a horizontal stimulus presented in a space perceived as larger will produce faster RTs. Twenty healthy subjects were asked to respond as quickly as possible to lateralized stimuli (horizontal line, vertical line and circle) presented on different backgrounds (control condition: evenly spaced vertical lines; illusory conditions: vertical lines progressively compressed to the right or left portion of the monitor). For horizontal stimuli only, subjects' RTs were reliably faster for stimuli presented on the compressed side of the gradient (275.8 ms) than on the relaxed side (279.9 ms). To verify the illusion of size, in a second experiment, the same subjects were asked to adjust the size of a stimulus (horizontal line, vertical line and circle) presented on the same backgrounds as Exp. 1 to make it equal to a reference stimulus. For horizontal lines, subjects produced adjustments in accordance with the predicted effect of the illusion. Together, these data show that the OKI produces a distortion of space for the horizontal dimension only and that RTs are influenced by the perceived and not the physical size of the stimuli.

H78

INVESTIGATING ERP MODULATION TO AFFECT AND CONGRUITY: IMPLICATIONS FOR POLITICAL PSYCHOLOGY Scott McLean[1], Sandra Wiebe[2], Michael Dodd[1], Kevin Smith[1], John Hibbing[1], Kimberly Andrews Espy[1]; [1]University of Nebraska-Lincoln, [2]University of Alberta — Recent findings suggest a role for genetic factors in political attitudes (Alford et al., 2005). Progress has been made to identify the intermediate links, often referred to as enodophenotypes (Gottesman & Gould, 2003), between genes and political attitudes. Using a modified Eriksen flanker paradigm, we have found that processing of affective stimuli across dimensions of congruity vary across political dimensions (McLean et al., In Progress). The purpose of this study is to investigate the neurological correlates of these findings. We recorded high density EEG while right handed undergraduate students from the University of Nebraska-Lincoln completed the Eriksen flanker paradigm with normally rated affective faces in congruent and incongruent trials. Participants pressed one of two buttons indicating like/dislike of the target image, ignoring flankers. Fifty percent of trials were incongruent. Participants reported their political orientation and completed a series of politically relevant questionnaires. Analyses of mean amplitudes by a repeated measures ANOVA reveal a main effect of target type around the peak amplitude 250-300 ms after stimulus onset (p=.011) in left centro-frontal leads. This finding revealed lower mean amplitudes for trials with happy targets compared to angry targets. Later (~280-300 ms) there was a significant interaction of flanker type and self reported political party around this later negative component (p =.047), where Republicans showed lower mean amplitude to happy flankers and Democrats showed lower mean amplitude to angry flankers. Results suggest processing differences in different political orientations. These findings are discussed in terms of implications to previous findings in political psychology.

H79

ERP CORRELATES OF FACIAL DISTINCTIVENESS: P2 SENSITIVITY TO IDENTITY STRENGTH Xin Zheng[1], Catherine J. Mondloch[1], Sidney J. Segalowitz[1]; [1]Brock University — Recent animal research and human imaging studies suggest neural responses are affected by the distinctiveness of face identity. Here we examined the influence of face distinctiveness on scalp-recorded event-related potentials (ERPs). We varied distinctiveness (identity strength) by morphing each of 36 faces (4 target and 32 non-target) with the average face created from the entire set; the relative weighting of the original face in each identity continuum ranged from 100% to 10% in 10% decrements. Seventeen female participants performed a face identity task with 4 blocks of trials, with participants pressing a button whenever a target face was detected. As faces move towards the "average" face, they became less distinctive, and participants' ability to identify target individuals follows a classic categorical boundary at 30%-to-50% weighting. P1 and N170 components to the nontarget faces were not affected by the distinctiveness of faces. The distinctiveness effect occurred later in the ventral parietal P2 component between 230 and 270 ms post stimulus-onset: as faces moved towards the "average" face, the P2 amplitude became smaller (p<.001) with no categorical boundary effect. When individual participant data were examined, this negative relationship between face distinctiveness and ventral P2 amplitude was found in 14 out of 17 participants from both left and right sides. Similar effects were also found when individual faces were examined after averaging across all participants. Our data are consistent with findings from previous imaging and animal research, and provide an ERP index to the neural mechanisms for the representation of face identities.

H80

DISSOCIATING BIOLOGICAL MOTION FROM FORM RECOGNITION: AN ERP STUDY Nicole White[1], Jonathan M. Fawcett[1], Aaron J. Newman[1]; [1]Dalhousie University — Humans are particularly sensitive to the movement of living creatures, and can recognize biological motion on the basis of only a few points of light (PLs) located on the body, in the absence of explicit form information. Indeed, human body forms and biological motion are preferentially processed by distinct occipito-temporal regions. The time course of neural activity associated with human form and motion information has been studied less extensively. Prior work demonstrated sensitivity of a posterior temporal event-related potential (ERP) component, the N300, to biological motion using PL stimuli, but did not dissociate the recognition of static human forms from that of biological motion. Thus, it is unclear whether the N300 is specific to recognition of human forms from motion, or if it indexes a more generic form-recognition process. To test these competing hypotheses, we recorded ERPs while participants viewed stimuli across 4 blocks: (1) static (non-moving) PL displays of humans performing actions; (2) static stick figures with clear forms; (3) PL biological motion; (4) static PL displays (repeated from block 1). An N300 was elicited by human forms in all blocks, and reliably discriminated between upright and inverted forms in blocks 2-4. Experience with PL stimuli over the course of the experiment led to greater N300 amplitude to static PL forms in block 4, an effect that was more pronounced for upright than inverted stimuli. The results suggest that the N300 indexes the recognition of human forms but is not specific to biological motion.

H81

A UNIFIED INFORMATION PROCESSING BOTTLENECK IN HUMAN PREFRONTAL CORTEX Michael Tombu[1], Christopher Asplund[1], Paul Dux[1,2], René Marois[1]; [1]Vanderbilt University, [2]University of Queensland — Information processing is characterized by bottlenecks that constrain throughput. The limitations imposed by these bottlenecks are especially evident when multiple streams of information are processed concurrently, as is the case in multitask settings. For example, working memory encoding can impair conscious perception of a concurrently presented target and ongoing decision-making in one task invariably postpones subsequent decision-making in a second task. While capacity-limited encoding and decisional processing are often treated separately, there is some behavioral and electrophysiological evidence that they require access to a common capacity-limited mechanism. In two dual-task experiments we explore the neural underpinnings of this putative unified bottleneck using time-resolved fMRI. The first experiment served to isolate a network of prefrontal brain regions that underlie the central, amodal bottleneck in response selection that limits dual-task performance. In the second experiment, we determined whether these brain regions were also affected by a manipulation of encoding load. Behaviorally, increasing the encoding load of Task 1 slowed down Task 2 response times at a short, but not at a long, SOA. Delayed peaks in hemodynamic activity, corresponding to reaction time delays associated with both encoding and decision-making bottlenecks, were found in a network of prefrontal regions. This core prefrontal network, including bilateral insula, left inferior frontal junction and anterior cingulate cortex, appears to constitute a unified information processing bottleneck responsible for operations as diverse as working memory encoding and decision-making.

H82

RAPIDLY CHARACTERISING MULTIDIMENSIONAL NEURAL TUNING TO SENSORY AND SEMANTIC FEATURES OF REAL-WORLD OBJECTS USING DYNAMICALLY ADAPTIVE IMAGING Rhodri Cusack[1], Michele Veldsman[1], Lorina Naci[2], Daniel Mitchell[1], Annika Linke[1]; [1]MRC CBU, Cambridge, UK, [2]University of Cambridge, UK — fMRI studies using multi-voxel pattern analysis have shown that different classes of realistic objects evoke distinct patterns of activity in human ventral visual cortex. As object classes differ in multiple sensory and semantic features from this it is not clear which subset of features the region encodes. Previous attempts to characterize encoding have used abstracted stimuli such as computer-generated objects or line drawings, and manipulated single features. Critically, the ability to generalize from these studies depends upon whether each feature independently determines the neural response. On the contrary, there is evidence from electrophysiology that neural tuning to objects reflects multidimensional selectivity to conjunctions of features, and from computational models, that object recognition proceeds through selective responses to complex combinations of features such as key parts of object classes. Here, we used a new real-time neuroimaging method, Dynamically Adaptive Imaging (DAI), that could reveal simultaneous tuning along a number of feature dimensions, permitting the use of naturalistic stimuli. As predicted, we found tuning to multiple features, both sensory and semantic, but with different patterns of selectivity for different objects. These results suggest: (1) there are limitations to studying single features independently; (2) feature selectivity differs in the neighbourhood of different object classes, as would be expected from some computational models of object recognition; and (3) DAI provides a powerful tool for the investigation of neural representations.

H83

WHAT'S THAT SECOND THINGY? ERP CORRELATES OF OBJECT RECOGNITION IN MULTI-STIMULUS DISPLAYS Sophie Trauer[1], Thomas Gruber[1,2], Matthias M. Mueller[1]; [1]University of Leipzig, [2]University of Osnabrueck — Only few event-related potential (ERP) studies examined familiarity of visual objects in terms of their conceptual long-term memory representations. Furthermore, the impact of rivalling objects within the spatial focus of attention remains largely unexplored. To shed some light on these unresolved issues, we presented line drawings of well-known objects and unnameable pseudo-objects, either as single or overlapping double stimuli, whereas always one of the drawings (the cued target) had to be judged as ‚existing' or 'not existing'. Earliest familiarity effects appeared for the posterior N1 (160-210ms), which was larger for unfamiliar compared to familiar stimuli. This effect might be explained by ongoing activity in early visual areas while no matching conceptual representation is found. From 250ms onwards, pseudo-objects led to more positive deflections at posterior sites. Two distinct components were identified: an early lateral-occipital component (220-280ms) reflected the overall amount of recognizable stimulus content in the display. The subsequent P3b-like positive complex reflected the required response, showing smaller amplitudes when the target was familiar. The influence of a second irrelevant drawing on that deflection was reduced to an interaction, which resulted in decreased familiarity effects under higher segmentation demands. Familiarity and segmentation demands separately shaped the late positive complex (500-750ms): a widespread parietal positive component mirrored the number of drawings, whereas its negative counterpart at frontal sites was modulated by familiarity of the target object. Thus disentangling sub-processes during object recognition, the present results indicate ERP components useful for future studies of visual processing in natural scenes.

H84

IS REPETITION SUPPRESSION MODULATED BY EXPERTISE? Alumit Ishai[1], Martin Wiesmann[1]; [1]University of Zurich, Switzerland — The extent to which repetition suppression is modulated by expertise is currently unknown. We used event-related fMRI to test whether architecture students would respond faster to building stimuli and would exhibit stronger repetition suppression in the fusiform gyrus (FG) and parahippocampal cortex (PHC) than students from other disciplines. Our subjects performed a working memory task with buildings from Barcelona and Tel Aviv. In each trial, a behaviorally relevant target and task-irrelevant distracter were repeated twice among novel distracters. Behaviorally, we found shorter response latencies with target repetition in all subjects. Moreover, the repetition of targets and distracters was associated with decreased neural responses in the FG and PHC in all subjects. Interestingly, in control, but not in architecture students, reaction times during the first repetition of the target were correlated with activation in multiple brain regions (cuneus, lingual gyrus, inferior parietal lobule, insula, and anterior cingulate cortex). Thus, despite the similar behavioral and neural responses observed in all subjects, the non-experts had to recruit additional regions in order to perform the task. Our findings suggest that as a result of their expertise, architecture students were able to encode and detect building stimuli at a lower neural cost.

H85

PERCEPTUAL LEARNING OF COMPLEX OBJECTS: MECHANISMS OF INTEGRATION ACROSS MULTIPLE VIEWS OF A NOVEL OBJECT IN CLUTTERED SCENES Lauren Emberson[1], Dima Amso[1]; [1]Weill-Cornell Medical School — We used a combined eye tracking/fMRI methods approach to examine the mechanisms by which the system integrates across multiple experiences of an object to achieve veridical perception. We asked whether repeated exposure to an occluded, novel object in variable contexts would result in perception of the object as a unified whole rather than two broken parts. In the structured condition, an "ambiguous" scene was paired with three others scenes that all included the occluded object in varying positions, orientations, and states of occlusion. In the unstructured condition, a similar "ambiguous" scene containing the same occluded object was paired with three visually unrelated scenes. We found that only structured exposure resulted in perception of the occluded object as unified, as revealed by post-test performance. Analyses of on-line eye movements revealed significant differences in fixation patterns across exposure conditions. Subjects directed a larger proportion of fixations at the occluded object in the structured condition versus at the occluder in the unstructured condition. Preliminary neuroimaging findings indicate occipito-hippocampal involvement in this task. Taken together, these data suggest that learning mechanisms, in concert with visual experience, shape the perception of complex novel objects supporting robust perception and segmentation.

H86

LONG-TERM EFFECTS OF PRENATAL EXPOSURE TO OMEGA-3 FATTY ACIDS ON VISUAL FUNCTION IN SCHOOL-AGE CHILDREN: A VISUAL EVOKED POTENTIAL STUDY Caroline Jacques[1,2], Ethier Audrey-Anne[1,2], Muckle Gina[3], Jacobson Sandra[4], Bastien Celyne[3], Dewailly Eric[5], Ayotte Pierre[5], Levy Emile[1,2], Jacobson Joseph[4], Saint-Amour Dave[1,6]; [1]CHU Sainte-Justine, Montréal, [2]Université de Montréal, [3]Université Laval, [4]Wayne State University, [5]Centre Hospitalier de l'Université Laval, [6]Université du Québec à Montréal — Findings from several studies indicate that omega-3 polyunsaturated fatty acids (n-3 PUFAs) are beneficial for the development of the visual system. However, little is known about the long-term effect of n-3 PUFA intake during gestation on child visual development. The long-term effects on visual development were assessed using visual evoked potentials (VEPs) in a cohort of school-age Inuit children exposed to high levels of n-3 PUFAs during gestation. VEP protocols using color and motion stimuli were used to assess parvocellular and magnocellular responses, respectively, in 136 children from Northern Quebec. Concentrations of the two major n-3 PUFAs (DHA and EPA) were measured in umbilical cord blood at birth and in child blood samples obtained at time of testing, reflecting pre- and postnatal exposure, respectively. Associations between n-3 PUFAs and VEPs were assessed by multivariate regression analyses to adjust for environmental contaminants and other potential confounding variables. No significant associations were found with motion-onset VEPs or with the child's current n-3 PUFA body burden. However, after adjustment for confounders, cord blood concentrations of DHA were associated with shorter latencies of the N1 and P1 components of the color VEPs. This study is the first to demonstrate beneficial effects of DHA intake during gestation on visual system function at school age. The data suggest that DHA is particularly important for the early development and long-term function of the parvocellular pathway, which plays a major role in visual processing of stimulus detail and chromatic analysis.

H87

THE SPEED OF FACE CATEGORIZATION IN THE HUMAN BRAIN: DISENTANGLING LOW-LEVEL PARAMETERS FROM HIGH-LEVEL FACE REPRESENTATIONS Stéphanie Caharel[1], Bruno Rossion[1]; [1]Université Catholique de Louvain, Belgium — The speed at which a visual stimulus is categorized as a face by the human brain remains debated. Indeed, despite years of research, event-related potentials (ERP) recordings have reported face-sensitive responses on the human scalp varying from 60 ms to 200 ms following stimulus onset (Bentin et al., 1996; Braeutigam et al., 2001; Itier & Taylor, 2002; Jeffreys, 1989; Rossion et al., 2000). Here, we disentangled the contribution of low-level parameters and high-level visual representations in accounting for early face-sensitivity in the human brain, by means of a factorial paradigm including faces and familiar objects (cars) and their respective scrambled counterparts using a Fourier phase randomization procedure. In fifteen participants, we replicated an early face-sensitivity - larger response to pictures of faces than cars – at the level of the P1 component (80-100ms). Importantly, this sensitivity to faces was accounted for completely by low-level parameters, the P1 being larger for scrambled faces as compared to scrambled cars (no interaction between phase-scrambling and category). In contrast, the following N170 component reflected the brain response to meaningful shapes, being almost non-existent for scrambled stimuli. As usually observed, the N170 was much larger in amplitude for faces than cars, an effect that was not accounted at all by low-level parameters (no significant difference between scrambled faces and cars). These observations indicate that preferential responses to faces may arise at several points in time, but that the earliest access to high-level face representations does not precede the occipito-temporal N170 onset in the human brain.

H88

TRACKING DOWN THE NEURAL MECHANISMS UNDERLYING PHASE INFORMATION PROCESSING OF FACES AND OBJECTS IN COMPLEX VISUAL SCENES Lisa Lombardi[1,2], Marine Houssa[1,3], Younes Zerouali[1,4], Bruno Rossion[3], Boutheina Jemel[1,5]; [1]Research Laboratory Neuroscience and Cognitive Electrophysiology, Hôpital Rivière-des-Prairies, [2]Concordia University, Montréal, Canada, [3]Université Catholique de Louvain-La-Neuve, Belgium, [4]École des Technologies Supérieures, Montréal, Canada, [5]Centre de Recherche Fernand-Séguin, Université de Montréal, Canada — While it is generally agreed that the outcome of early vision constitutes the building block of visual perception (face and object perception), it still remains unclear how the output of early visual processes temporally and spatially aggregate within the visual cortical pathways leading to a face or object percept. To address this issue, we investigated event-related potential responses (ERPs) to shape detection of cars and faces in complex visual scenes. Shape information was manipulated by gradually scrambling the distribution of phase values of each image using 6 levels of phase randomization (28%, 48%, 56%, 65%, 74%, 100%). Face-car detection rates improved in a non-linear fashion with decreasing levels of phase randomization. Interestingly, they were very high (~ 85.2%) when only 52% of shape information was available in the images (i.e. 48% scrambling level). Early visual ERPs (i.e. P1) did not show any amplitude difference between scene images with faces and cars and more importantly across phase scrambling levels. Moreover, amplitude changes at the level of the occipito-temporal N170 component for both faces and cars occurred only between 28% and 48% phase randomization levels. No N170 amplitude differences were found between phase randomization levels from 48% to 100%. Our ERP findings indicate that early visual areas send undifferentiated input signals about phase information to higher-level visual areas where they are integrated (synthesized) into a coherent meaningful shape, and thus further support the notion that face and object shape processing is temporally tied to the occurrence of the N170 electrophysiological response.

H89

ILLUSION OF VISUAL MOTION INDUCED BY ELECTRICAL STIMULATION OF HUMAN AREA MT+ Andreas M. Rauschecker[1,2], Aslihan Selimbeyoglu[3], MoD Dastjerdi[3], Josef Parvizi[2,3]; [1]MSTP Training Program, [2]Neuroscience Program, [3]Stanford University — We explored the relationship between task-induced fMRI BOLD and electrophysiological activity and alteration of human conscious visual perception by electrical stimulation of the brain. Three patients with epilepsy, which were later implanted with intracranial electrodes, underwent functional imaging during a visual motion perception (MT-localizer) task aimed at identifying motion-responsive areas within the brain. In each subject, a higher level of BOLD signal was seen bilaterally in an area consistent with the location of area hMT+ during moving compared to static stimuli. In one subject who performed the same MT-localizer task during intracranial electrophysiological recording, higher theta and gamma band power was seen, during the motion compared to static condition, only in the area overlapping the BOLD region in the hMT+. In two subjects, only when the electrical charge was delivered in the electrodes within the BOLD region, idiosyncratic and stereotyped illusory percept of visual motion was elicited. One subject experienced displacement of the entire visual field to the contralateral side (optical allesthesia), and another subject experienced vibrating and moving of parts of the contralateral visual field in a directionally-specific manner. In the third subject, in whom the electrical stimulation was near, but not within the BOLD area, electrical charge delivery did not elicit any subjective experience related to visual motion. Our findings provide evidence, in the human brain, for a clear relationship between task-induced fMRI BOLD and electrophysiological activity, and that electrical charge delivery into the hub of this activity leads to a change in the conscious human experience.

H90

DORSAL STREAM ACTIVATION AND VENTRAL STREAM SUPPRESSION IMMEDIATELY PRECEDE PERCEPTUAL REVERSALS DURING BINOCULAR RIVALRY: AN ELECTRICAL SOURCE IMAGING STUDY Juliane Britz[1], Michael Pitts[2]; [1]University of Geneva, [2]University of California, San Diego — Pre-stimulus fluctuations of neuronal activity usually dismissed as noise have recently been shown to influence subsequent stimulus processing. In a previous study, we found that spontaneously emerging activity as indexed by pre-stimulus EEG topography predicts perceptual reversals of the Necker cube. The sources of the pre-stimulus EEG topographies dissociated perceptual reversals from non-reversals in right inferior parietal cortex. In the present study, we investigated perceptual reversals for intermittently presented stimuli during binocular rivalry and physical alternation while the ongoing EEG was recorded from 64 channels. We identified EEG topographies (functional microstates) immediately preceding the stimulus-onset and identified two topographies that doubly dissociated perceptual reversals from non-reversals. The estimated intracranial generators associated with these topographies were stronger in right inferior parietal cortex and weaker in the ventral stream before perceptual reversals. No such differences were found for physical alternation of the same stimuli. Post-stimulus ERPs and their concomitant sources differed in three time windows: reversals were associated with increased activity in early visual areas (~100 ms) and decreased activity in the ventral stream (~200 – 300 ms) and frontal areas. Taken together with our previous findings, these results suggest common neural mechanisms associated with perceptual reversals during binocular rivalry and ambiguous figure perception. In both cases, the dorsal stream is more active while the ventral stream is less active before perceptual reversals.

H91

MAGNOCELLULAR PROCESSING DIFFERENCES FOR PERIPHERAL STIMULATION AMONG CHILDREN WITH AUTISM SPECTRUM DISORDERS: EVIDENCE FROM HIGH-DENSITY EEG Natalie Russo[1,2], Hans-Peter Frey[1,2], Edmund Lalor[3], Sophie Molholm[1,2], John J. Foxe[1,2,3]; [1]City College of New York, [2]Albert Einstein School of Medicine, [3]Trinity College, University of Dublin — Individuals with autism spectrum disorders (ASD) frequently show self stimulatory behaviors related to visual processing such as gazing at objects or their fingers in the periphery. This behavior, termed 'lateral glancing' is considered by some to reflect an attempt to filter visual stimulation. The origin of this behavior is thought to be related to differences in ASD in the functioning of magno- and parvo-cellular visual pathways. Here we present electrophysiological data on children with ASD and typically developing children (TD) assessing the integrity of magno- and parvo-cellular pathways. To this end, we used standard visual evoked potentials (VEP) which contain information from both pathways and the novel event-related potentials technique known as the VESPA (Visual Evoked spread Spectral Analysis) to independently stimulate magno- and parvo-cellular pathways via the use of low and high contrast flickering stimuli respectively. Participants detected an infrequent target presented in the center of the screen to ensure that they were fixating, while checkerboards flickered at the appropriate contrast (VEP, magno and parvo VESPA). Stimulation was presented in both central and peripheral locations. Centrally, evoked responses were similar across all conditions. At peripheral locations, parvo VESPA were similar between groups, but the magnitude of the VEPs and magno VESPA were much larger in the children with ASD than in the group of TD children. These findings support the notion of a relatively typical parvo- and an atypical magno-cellular system among children with ASD in the visual periphery.

H92

OPTIMAL SPATIAL-FREQUENCY RANGE FOR THE ELECTROPHYSIOLOGICAL RESPONSE TO FACES Marine Houssa[1], Lisa Lombardi[2], Frédéric Gosselin[3], Boutheina Jemel[3]; [1]Université Catholique de Louvain La Neuve, [2]Concordia University, [3]Université de Montréal — It has been shown that face recognition depends on a limited range of spatial frequency (SF) bands (centered on ~10 c/f —cycles/face—and ~1.5 octave wide). In addition, the M170, an electromagnetic brain response to faces, was found to be sensitive to a similar SF band. The present experiment was designed to further document the response tuning of the N170 event-related potential component to faces using contrast-sensitivity measures. Stimuli consisted of bandpass filtered face images, using 5 non-overlapping SF bands with 1-octave bandwidth each: 1.5-3, 3-6, 6-12, 12-24, 24-48 c/face. Stimulus energy was equated across SF conditions. Seven Weber contrast-luminance levels were applied to each SF condition, from 10 to 70% with steps of 10%. ERP responses were recorded while participants viewed faces with different SF bands and contrast levels. ERP results show that N170 amplitudes were modulated both by SF and contrast. Interestingly, we found that the N170 responses exhibited low contrast thresholds to faces with 6-12 c/f SF and more particularly those with 12-24 c/f bands. N170 showed high contrast thresholds to faces with 24-48 c/f SF band. The N170 peak was very small to faces with 1.5-3 c/f SF band. Our N170 findings indicate that the neural responses to faces are tuned to specific spatial frequency bands, the range of which is slightly shifted toward higher spatial frequencies compared to the one showed to be critical for recognizing faces.

H93

THE BANK OF STANDARDIZED STIMULI (BOSS): A NEW SET OF 538 NORMALIZED PHOTOS OF OBJECTS TO BE USED AS ECOLOGICAL STIMULI IN VISUAL COGNITION RESEARCH Mathieu B. Brodeur[1], Melissa Chauret[2], Genevieve Dion-Lessard[2], Tina Montreuil[3], Emmanuelle Dionne-Dostie[2], Martin Lepage[1]; [1]McGill University, [2]Universite de Montreal, [3]Universite du Quebec a Montreal — There are currently several normalized databases available to investigate psycholinguistics and visual cognition. Norms represent valuable information that can be used as experimental variables of interest or they can be systematically controlled to limit their potential influence on another experimental manipulation. The most established normalized database of stimuli to be used in visual cognition is the Snodgrass and Vanderwart (1980) set of black and white pictures. The present work proposes an alternative set of 1,460 high quality photo stimuli. Stimuli are common objects among which 538 were normalized for name, category, familiarity, visual complexity, object agreement, viewpoint agreement, manipulability, color, color diagnosticity, and material. Of these objects, 209 have more than one exemplar and 386 have been photographed under different viewpoints. Stimuli are also available in greyscale, blurred, scrambled, and line-drawn version. This Bank Of Standardized Stimuli (BOSS) proposes ecological stimuli and new norms and was created specifically to meet the needs of scientists in cognition, vision and psycholinguistics.

H94

MAGNITUDE COMPARISON IN FEMALES WITH THE FRAGILE X PREMUTATION Naomi J. Goodrich-Hunsaker[1], Ryu I. Hashimoto[2], Naomi V. Hatt[2], Heather M. Shapiro[3], Lyndsey Marcelino[3], Yingratana McLennan[3], Christine Godwin[3], Flora Tassone[3,4], Susan M. Rivera[2,3], Tony J. Simon[3]; [1]NeuroTherapeutics Research Institute, University of California, Davis Medical Center, [2]Center for Mind and Brain, University of California, Davis, [3]M.I.N.D. Institute, University of California, Davis Medical Center, [4]School of Medicine, University of California, Davis — Fragile X premutation carriers (fXPCs) are defined by the presence of a trinucleotide expansion between 55 and 200 CGG repeats in the in the 5′ untranslated region of the fragile X mental retardation 1 gene (FMR1). It is unclear to what extent female fXPCs are neurocognitively affected as recent reports of visual processing and spatial attention deficits suggest previously overlooked cognitive dysfunction. Our purpose was to assess magnitude estimation in fXPCs and correlate behavioral and fMRI results with molecular variables of the FMR1 gene (e.g., CGG repeat length). Female fXPCs and neurotypical (NT) control participants completed a magnitude comparison task in which they judged which of two stimuli was larger. Response time and error rate were used to assess performance. To determine the neuroanatomical correlates of magnitude comparison, participants completed a magnitude comparison task variant during an fMRI scan. Female fXPCs responded more slowly than NT participants, yet there were no significant differences in error rates between the two groups (< 10%). On the fMRI variant, female fXPCs performed similarly to NT participants both in reaction time and accuracy. However, NT participants had significantly greater intraparietal activation compared to fXPCs. Significant negative correlations with CGG repeat length were primarily found bilaterally in the intraparietal sulcus and in the right dorsolateral prefrontal cortex. Results from this study provide novel evidence for disrupted magnitude comparison competence and atypical neural activation in female fXPCs that appears to relate to the "dosage" of the FMR1 gene mutation.

H95

NEURAL CORRELATES OF TEMPORAL INTEGRATION IN FACE RECOGNITION: AN FMRI STUDY Yunjo Lee[1], David Anaki[2], Cheryl Grady[1,3], Morris Moscovitch[1,3]; [1]Rotman Research Institute, Baycrest Centre, [2]Hebrew University of Jerusalem, [3]University of Toronto — Anaki and Moscovitch(2007) showed that face parts, separated by intervals up to 400ms, can be combined into a unified representation and undergo configural processing; beyond 400ms part-based processing prevails. Using fMRI, we investigated the neural correlates of facial temporal integration and whether regions implicated in face recognition differ for short vs. long intervals. In each trial, top and bottom parts of a famous face were presented for 17ms each with a 0ms(ISI0), 200ms(ISI200), or 800ms interval(ISI800) between the parts. As a control, a misaligned face whose top and bottom parts were spatially separated was shown for 17ms(MIS). Participants responded whether they recognized the face. A post-scan test(outside the scanner) examined the participant's knowledge about famous faces shown in the scanner and faces unknown to each participant were excluded from data analysis. A multivariate analysis explored the relationship between brain activity and recognition performance. Better recognition in ISI0 and ISI200 was associated with increased activity in classical face recognition regions, such as right fusiform and bilateral inferior/middle occipital gyri, as well as lingual, inferior/middle/medial frontal, middle temporal, cingulate gyri and precuneus. Successful recognition in ISI800 and MIS relied on increased activity in left anterior fusiform gyrus, left inferior frontal and bilateral middle temporal gyri. Integration of face parts with a short interval involves areas implicated in configural face processing, whereas recognition with an 800ms interval involves regions implicated in part-based processing, which also are used to recognize misaligned faces. It is possible that configural processing involves temporal integration over short intervals.

H96

IS GLOBAL STEREOPSIS PRESENT IN MICROSTRABISMIC CHILDREN? Mariline Pageau[1], Danielle de Guise[1], Dave Saint-Amour[1,2]; [1]Université de Montréal, [2]Université du Québec à Montréal — Convergent strabismus is a common condition in children which has been divided into several categories including microstrabismus. It is generally accepted that stereopsis is present in patients with microstrabismus, although it is reduced. However, this concept relies primarily on the evaluation of local stereopsis, which contains visible local indices and monocular cues. A sample of 26 children (6 to 14 years of age) with microstrabismus was selected at the Clinique Universitaire de la Vision of University of Montreal. All 26 children were diagnosed with microstrabismus. Their local and global stereoscopic thresholds were obtained using the Randot® test. Nineteen children with microstrabismus (19/26, 73%) had local stereopsis of 50 seconds of arc or worst. A complete lack of stereopsis was observed in 7 (27%) children. Interestingly, none of the children tested was able to perceive global stereopsis with the exception of one child during only one of the follow up visits. This study shows the relevance of testing both local and global stereopsis to assess the integrity of binocular vision. Many patients with microstrabismus show some degree of depth perception but only when measured with local stereopsis. Normal stereoscopic vision implies also the ability to discriminate random dot stereograms. A measurement of global stereoscopic threshold should therefore be performed with all patients in order to acquire a much more reliable estimate of their level of stereoscopic vision. A pilot psychophysical study to compare local and global stereopsis capacities in microstrabismic children to precisely determine their stereoperception ability has already begun.

H98

EARLY VISUALLY EVOKED ELECTROPHYSIOLOGICAL RESPONSES OVER THE HUMAN BRAIN (P1, N170) SHOW STABLE PATTERNS OF FACE-SENSITIVITY FROM 4 YEARS TO ADULTHOOD Dana Kuefner[1], Adelaide deHeering[2], Corentin Jacques[3], Ernesto Palmero-Soler[1], Bruno Rossion[1]; [1]Universite Catholique de Louvain, [2]McMaster University, [3]Stanford University — The aim of this experiment was to characterize the developmental trajectory of event-related potential (ERP) components related to face-processing, and to determine if any age-related changes in these components are specific to faces. Studies recording event-related potentials (ERPs) in response to faces from 5-16-year-old children report large age-related changes in amplitude, latency (decreases) and topographical distribution of the early visual component P1 and the occipito-temporal N170 (Taylor, Batty & Itier, 2004). To test the face specificity of these effects, we recorded high-density ERPs to pictures of faces, cars, and their phase-scrambled versions from 72 children between 4 and 17 years, and adults. We found that none of the age-related changes in amplitude, latency or topography of the P1 or N170 were specific to faces. Most importantly, when we controlled for age-related variations of the P1, the N170 appeared remarkably similar in amplitude and topography across development, with much smaller age-related decreases in latencies than previously reported. At all ages the N170 showed equivalent face-sensitivity; it was absent for scrambled stimuli, larger and earlier for faces than cars, and had the same topography across ages. These data also illustrate the large amount of inter-individual and inter-trial variance in young children's data. We propose that this variability causes the N170 to merge with a later component, the N250 in grand-averaged data, explaining the previously reported "bi-fid" N170 of young children. Overall, we conclude that the classic electrophysiological markers of face-sensitive perceptual processes do not appear to change from 4 years to adulthood.

H99

VISUAL REHABILITATION OF MACULAR DEGENERATION PATIENTS EXPANDS REORGANIZED MAPS ON THE VISUAL CORTEX Keith Main[1], Temilade Adelore[1], Donna Inkster[2], Jeff Horton[2], Susan Primo[2,3], Paul Corballis[1], Eric Schumacher[1]; [1]Georgia Institute of Technology, [2]Emory Eye Center, [3]Emory University School of Medicine — Recent research indicates that an alteration of retinotopic maps (cortical reorganization) can occur in adult humans with the eye disease macular degeneration (MD), a retinopathy that results in the loss of central vision (Baker et al., 2005, Schumacher et al., 2008, Dilks et al., 2009). Questions remain, however, regarding whether observations of "reorganization" represent a feed-forward alteration of cortical circuitry or simply the expansion of attentional feedback into the lesion projection zone (Masuda et al., 2008). In order to better understand how retinotopic reorganization may relate to the visual abilities of those with low vision, we performed fMRI scans on MD patients before and after they underwent visual rehabilitative therapy. The therapy was designed to strengthen the use of the preferred retinal locus (PRL), an area of the retinal periphery that MD patients often use for fixation in the absence of a functional macula. Visual stimulation of the PRL revealed an expansion of cortical maps into the lesion projection zone after visual rehabilitation, particularly for attention demanding tasks. These findings suggest that adaptive patterns of attentional allocation and oculomotor control may influence the presence and degree of reorganization within the primary visual cortex. This knowledge could potentially help visual scientists understand the physiological mechanisms of reorganization as well as its relationship to visual adaptation.

H100

TWO ROUTES TO ACTION PRODUCTION OF NOVEL OBJECTS Asmaa Dabbagh[1], Eric A. Roy[1], Genevieve Desmarais[2], Mike J. Dixon[1]; [1]University of Waterloo, [2]Mount Allison University — Past research using novel objects has shown that action production is affected by the similarity of objects to which actions are associated. However, the role of semantics in producing actions for novel objects remains unclear. In our study, we asked participants to learn novel object-label-action associations using meaningful labels. Half of labels were semantically similar and half were semantically dissimilar. After a first learning session (day 1), participants practiced actions of objects over three sessions (days 2-3-4) before being tested on the associations again (day 5). In addition, participants were tested on actions using a cylinder, where they were provided with one of previously learned labels and were asked to produce the action on the cylinder corresponding to that label. Analysis showed that before and after practice, participants made more action errors with cylinder for objects associated with semantically similar labels than objects associated with semantically dissimilar labels. In addition, before practice, participants produced more action errors for objects associated with semantically similar labels than objects associated with semantically dissimilar labels. However, after practice, participants made equivalent numbers of action errors for objects that are associated with semantically similar and dissimilar labels. Overall, when producing actions with cylinder or with novel objects before practice, participants were likely using indirect route to action production via semantics. However, when producing actions with novel objects after practice, participants were likely using direct route to action production after practice.

H101

DIFFERENT SPATIAL FREQUENCY TUNING FOR FACE IDENTIFICATION AND FACIAL EXPRESSION RECOGNITION IN ADULTS Xiaoqing Gao[1], Daphne Maurer[1]; [1]McMaster University — Facial identity and facial expression represent invariant and changeable aspects of faces, respectively. The current study investigated how human observers (n=5) use spatial frequency information to recognize identity versus expression. We measured contrast thresholds for the identification of faces with varying expression and for the recognition of facial expressions across varying identity as a function of the center spatial frequency of narrow-band additive spatial noise. At a viewing distance of 60 cm, the peak threshold representing maximum sensitivity was at 11 cycles/face width for identifying the faces of two males or two females with varying expression. The peak threshold was significantly higher for recognizing facial expressions across varying identity: it was at 16 cycles/face width for discriminating between happiness and sadness, and between fear and anger, whether the expression was high or low in intensity. In a second phase we investigated the effect of viewing distance. As viewing distance increased from 60 to 120 and 180 cm, the peak threshold for identifying faces shifted gradually from 11 to 8 cycle/face width, while the peak threshold for recognizing facial expressions shifted gradually from 16 to 11 cycles/face width. In conclusion, we found that the optimal spatial frequency band for the recognition of facial expressions is higher than for the identification of faces regardless of viewing distance. The patterns suggest that finer details are necessary for recognizing facial expressions than for identifying faces and that the system is only partially scale invariant.

H102

ELEMENTAL AND CONFIGURAL BODY REPRESENTATION IN THE EXTRASTRIATE AND FUSIFORM BODY AREA Barbara Vogt[1], Nicole David[2], Simone Schütz-Bosbach[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]University Medical Center Hamburg-Eppendorf, Hamburg, Germany — Previous research on visual processing of the human body has suggested a qualitatively different involvement of two specific regions in the visual cortex: the extrastriate body area (EBA) and the fusiform body area (FBA). While the EBA seems to process bodies on the level of single elements, the FBA may analyze the configuration of bodies in a holistic manner. Further investigating this potential functional distinction, using fMRI, we presented participants with static human body photographs of varying completeness (from arm or leg to full body), in intact or scrambled configuration. If the EBA processed bodies only on the level of parts, we expected the fMRI response magnitude to increase gradually as a function of the amount of body shown, irrespective of configuration. If the FBA processed human body shapes holistically, we expected to find increased activation of the FBA for intact versus scrambled bodies. We found that the FBA showed a preference for intact bodies, compared to scrambled body stimuli, whereas the EBA did not show this differential activation. However, no gradual increase of activation was observed in either area as a function of amount of body displayed. Our findings nevertheless suggest that the EBA indeed processes body parts rather than the body as a whole, while the FBA seems to represent body configuration in a holistic fashion.

H103

PATIENTS WITH PARKINSON'S DISEASE SHOW NEGATIVE BIAS OF FACIAL EXPRESSIONS Chia-Yao Lin[1], Li-Chuan Hsu[1,2], Chon-Haw Tsai[1,3], Yi-Min Tien[4]; [1]Graduate Institute of Neural and Cognitive Sciences of the China Medical University, Taichung, Taiwan, [2]Medical College of the China Medical University, Taichung, Taiwan, [3]Neuroscience Laboratory, China Medical College Hospital, Taichung, Taiwan, [4]Chung Shan Medical University, Taichung, Taiwan — Besides movement disorder, Parkinson disease (PD) patients are revealed to have non-motor deficits (Zgaljardic, et al., 2003). Moreover, they are often diagnosed as having depression (Cummings, 1992; Doonief, et al., 1992). Depressed patients are reported to be associated with some deficit in emotional perception (Gur et al., 1992), such as "negative bias" in which they tend to misperceive a happy face as a neutral one or to misperceive a neutral face as a negative one. The main purpose in the present study is to investigate whether PD patients have negative bias as showed in depressed people. In Experiment 1, we asked PD patients and age-matched normal controls to directly discriminate positive and negative faces (emotional discrimination task, EDT). In Experiment 2, we asked them to identify gender (male or female) according to faces (gender identification task, GIT). The GIT is an indirect task in which participants did not have to pay attention to the facial expression. We found PD patients discriminated positive faces much slower and less accurate than negative faces (Experiment 1). We also found their performance in the GIT would be interfered when the face was positive (Experiment 2). We concluded PD patients, as depressed people, misperceived emotional faces in both tasks, regardless of whether the task demand was explicitly related to facial expressions or not. The relationship between PD's performance on emotional perception and their depressed index from Beck Depression Inventory was also discussed.

H104

OPTIMAL EYE-FIXATION POSITIONS FOR FACE PERCEPTION: A COMBINED ERP AND EYE-TRACKING STUDY Younes Zerouali[2,3], Boutheina Jemel[1,2]; [1]Université de Montréal, [2]Hôpital Rivière-des-Prairies, Montréal, [3]École de Technologie Supérieure, Montréal — Previous research has outlined the existence of a saliency map among facial features, where the general order of saliency is eyes, nose, mouth. In addition, event-related potential studies showed that the face-sensitive N170 is particularly sensitive to face features, being larger to isolated eyes relative to other face features, and even to a whole face. Although these results suggest that the N170 could be triggered by the eye-region, there is as yet no direct investigation of the N170 response profile when viewers fixate specific facial features within a whole face context. To address this question, EEG and eye-tracking measurements were recorded and monitored simultaneously to allow an accurate sampling of electrical brain signals from fixated face regions, while participants viewed faces in upright or inverted presentations. ERPs were averaged by gaze location (eyes, inion, eyebrows, nose, mouth and jaws). Analyses revealed that the optimal fixation position on an upright face (i.e., eliciting the largest N170s) is located around the nasion (triangle between to two eyes and the upper ridge of the nose). Interestingly for inverted faces, the optimal positions are more variable, but mainly clustered in the upper part of the visual field (around the mouth). Our results suggest that the N170 is not driven by the eyes per se, but could rather arise from a general perceptual setting (upper-visual field advantage). It is also possible that the upper part of faces (eyes) serves as an artificial horizon to align a face stimulus on a stored face template.

H105

BRAIN CORRELATES OF HUMAN MOVEMENT PERCEPTION: A QUANTITATIVE VOXEL-BASED META-ANALYSIS Susan Beaton[1], Marie-Helene Grosbras[1]; [1]University of Glasgow — Numerous brain-imaging studies have investigated neural correlates of perceiving social signals conveyed by face, hand and body movements. But, single fMRI studies often employ only one type of stimulus and context, producing disparate results. Pooling results from several studies enables a clearer picture of which brain regions are consistently engaged when we watch other people moving. We performed a voxel-based meta-analysis of 63 brain imaging studies using Activation Likehood Estimation. For each experiment, each reported stereotaxic coordinates of maxima were modeled as a gaussian distribution to derive a probability map. Averaged probability maps are computed for each condition (Face, Hand and Body), reflecting, at each voxel, the probability that any study examining this category of movement perception would report an activation. Only bilateral MT and a region of the right posterior superior temporal sulcus (STS) showed reliable across-study convergence for all conditions. We observed significant activation likelihood in precentral, parietal and middle temporal cortice for all conditions, but maxima for the different conditions were topographically organized. We observed specificity for face perception in pre-SMA and anterior superior temporal gyrus; and specificity for Body in the fusiform gyrus, superior marginal gyrus and amygdala. This is the first quantitative synthesis of brain imaging data on biological motion perception. It points towards a special role for posterior STS and supports specificity for body parts in precentral and parietal areas, in accordance with the putative mirror neuron system organization. Finally, it provides important reference to ground further brain imaging, brain stimulation and patients studies.

H106

SUMMARY STATISTICS OF A SET OF STIMULI OCCURS IN PARALLELS
Nicolas Robitaille[1], Irina Harris[2]; [1]BRAMS, International Laboratory for Brain, Music and Sounds Research, [2]University of Sydney — Despite the several processing limitations that have been identified in the visual system, it was shown that statistical information about a set of objects could be perceived as accurately as the information about a single object. This processing, refer to as summary statistics, was always assumed to occurs in parallels, but this has never been demonstrated directly. We created a new task that allowed us to calculate the reaction time necessary to extract statistical information (average of orientation or size) from a set of stimuli. Precisely, we used a single fixed target for the entire experiment, and subjects had to indicates as quickly as possible if the average of the set was, for example, bigger of smaller that the target. We found that increasing the number of stimuli in the set does not increase the time required to make a judgement about a statistics of the set (either the orientations of bars or the size of disks), while identifying a specific instance of these object does increase reaction time, thus creating the classical positive search slope. In fact, in most case the actual reaction time decreased when the numbers of items was increased. In every case, the accuracy was either stable or increased with the numbers of items. These results indicate that, in addition to the well-studied capacity-limited processing pathway, there is complex information that can be extracted in parallels from several objects.

H107

NON-OBJECT IMPLIED MOTION IN PAINTINGS ACTIVATES MOTION PROCESSING REGION MT+
Preston P. Thakral[1], Lauren R. Moo[2], Scott D. Slotnick[1]; [1]Boston College, [2]Massachusetts General Hospital — Implied object motion, which is commonly elicited by static images of moving objects, can activate motion processing region MT+. We hypothesized that MT+ would also be activated by non-object implied motion in paintings, conveyed via brushstrokes (e.g., van Gogh's 'Starry Night'). During fMRI, participants made pleasant-unpleasant responses when presented with 20 van Gogh paintings (which were repeated), selected to span a wide range of subjective motion from no implied motion to a high degree of implied motion (participants were instructed to make an approximately equal number of both responses, to motivate detailed analysis of each painting). Participants also completed an MT+ localizer comprised of alternating periods of moving/stationary dots. Post-scanning, each participant rank ordered the previously presented paintings from the lowest to the highest degree of subjective motion, and also marked a boundary below which paintings were stationary and above which paintings were moving. A region-of-interest (ROI) analysis was conducted where, on an individual participant basis, left and right MT+ were identified using the localizer and then event-related activation timecourses were extracted corresponding to stationary and moving paintings (based on each participant's stationary-moving boundary). In support of our hypothesis, in left MT+, paintings classified as moving produced significantly greater activity than paintings classified as stationary. A parametric analysis further revealed a significant correlation between the degree of subjective motion and the magnitude of activity in left MT+. Based on these findings, we speculate that paintings are not processed holistically, but rather are neurally decomposed into implied component visual features.

H108

FMR ADAPTATION OF PARTS AND WHOLES IN VISUAL CORTEX
Anthony Cate[1], Xiaojian Kang[1,2], Timothy Herron[1], David Woods[1,2,3,4]; [1]Veterans Affairs Northern California Health Care System, [2]University of California, Davis, [3]University of California, Davis, Center for Neuroscience, [4]University of California, Davis, Center for Mind and Brain — This study distinguished between responses to object parts or to whole shapes by presenting the same stimuli in different combinations in a blocked fMR adaptation design. Planar shape parts were joined together to form the top and bottom of abstract objects, which were presented during three kinds of stimulus set: one with 4 unique objects created from a set of 4 parts (two unique top parts, two unique bottom parts); 4 objects from 8 parts; and 16 objects from 8 parts. All part combinations appeared with equal frequency in all conditions. Sets of stimuli were presented sequentially at 2 Hz during 16 s epochs, with interleaved fixation epochs. Analysis included regressors that modeled the effects of the frequency of 1-back repetitions (for both parts and objects) independently from the effects of total number of unique parts or objects in an epoch. Two ventral stream regions (lateral occipital sulcus and fusiform gyurs) responded to increased shape variety; in both regions part-sensitive voxels were anterior to object-sensitive voxels. Thus independent representations of part shapes may persist at relatively high levels of the ventral visual hierarchy. In contrast, the medial intraparietal sulcus, retrosplenial cortex and posterior parahippocampal gyrus showed greater responses when the number of unique objects (but not parts) was lower, as well as when the same object (but not part) repeated. Integrated objects appear to be a unit of analysis not only in the posterior parietal lobe, but also in functionally connected ventromedial regions.

H109

GAMMA OSCILLATIONS DURING SWITCHES IN OBJECT PERCEPTION
Hans-Peter Frey[1,2], Marnix Naber[3], Wolfgang Einhauser[3], John Foxe[1,2]; [1]City College of New York, [2]Albert Einstein College of Medicine, New York, [3]Philipps-University Marburg — The neurophysiological mechanisms of conscious object perception are largely unknown. Several theoretical and experimental studies have suggested that gamma oscillations play an important role in this process. Ambiguous figures are prominent stimulus candidates for examining object perception. Observers usually perceive these figures as switching between different states even though the physical stimulus isn't changed. In this study we examine the role of gamma oscillations in switches of object perception. Participants were presented a stimulus consisting of a square that translates behind three occluders. The perception of this stimulus switches between a square translating around the fixation spot and edges in an up-down motion. The great advantage of this type of stimulus is a long duration of each object percept (usually around 5s). Static and rotating Necker cubes were used as control stimuli for rivalrous perception and motion integration. We recorded high-density EEG while participants indicated endogenous perceptual switches between the different percepts. We determined EEG gamma-band activity using the Hilbert-transform of IIR filtered data and calculated the phase locking value. In addition to decreased amplitude we find a decrease of phase coherence across trials in a narrow band around 40 Hz starting around 650ms before indicated switches of perception for the translating square. This decrease likely signals switches in object perception, since it is absent in static and rotating Necker cube trials. Our results suggest that oscillatory gamma activity plays a role in switching between different object percepts.

Long-Term Memory: Development & Aging

H110

CORTISOL INCREASES IN MILD COGNITIVE IMPAIRMENT OCCUR ONLY IN INDIVIDUALS WHO PROGRESS TO DEMENTIA Genevieve Arsenault-Lapierre[1], Sonia Lupien[2], Howard Chertkow[1]; [1]McGill University, [2]Université de Montréal — Patients with Alzheimer's disease (AD) secrete more cortisol (a stress hormone) than normal elderly (NE). Recently it has been shown that individuals with Mild Cognitive Impairment (MCI), who are at increased risk for progression to AD, also have higher levels of cortisol than NE. However, it is not clear if this is due to disease progression or to other factors, such as time or age. Therefore, the goal of our study was to verify that cortisol secretion is stable in NE but increases over time in MCI, especially those who progress to AD. Sixty-one MCIs and 30 ADs were recruited from the Jewish General Hospital (JGH) memory clinic and 34 NEs were recruited from the JGH family medicine clinic and newspapers. MCIs were followed annually and were diagnosed as either progressors (MCIp) or non-progressors (MCInp). Salivary cortisol samples were collected one day at baseline and two years later at follow-up. Paired t-tests were performed. Twenty-one NE, 18 MCInp, 4 MCIp and 11 AD complete d the study. They did not differ from the initial cohort, but more MCIp were lost to attrition. AD included in our study were older ($p=0.03$). Cortisol levels of NE, MCInp, and AD were statistically stable from baseline to follow-up (all $p>0.05$), whereas the cortisol levels of MCIp showed a statistically significant increase ($p=0.01$). These results suggest that time (or age) is not a factor in cortisol increase. Our results suggest that increasing cortisol may reflect disease progression, or accompanying stress related to worsening memory loss.

H111

IDENTIFYING REGION-SPECIFIC PREFRONTAL CORTEX VOLUME CHANGES THAT ARE ASSOCIATED WITH AGE-RELATED DECREMENTS IN CONTEXT MEMORY RETRIEVAL Rafael Languay[1], Luc Valiquette[2], Natasha Rajah[3]; [1]Douglas Mental Health University Institute, Research Centre, [2]Douglas Mental Health University Institute, Gerontopsychiatry Division, [3]McGill University — Our lab published results from an event-related fMRI study in which 21 healthy young adults (mean age 24.3) and 21 healthy elderly (mean age 67.7) performed item recognition, spatial context retrieval and temporal context retrieval tasks within the same experimental session (Rajah et al., 2009). The fMRI results indicated that age-related reductions in context retrieval were associated with changes in left superior frontal gyrus (SFG) and right middle frontal gyrus (MFG) activity. In this followup study we examined the volumes of these PFC regions of interest (ROIs): bilateral SFG and MFG, in the same sample of young and older subjects using a semi-automatic segmentation method called DISPLAY (Collins, L et al., 1999). We conducted a group-by-PFC ROI analysis of variance to determine which ROIs exhibited age-related reductions in volume. We also examined the 3-way correlations between PFC ROI volumes, activity and accuracy, within task, for each age group. Our results indicate that older adults exhibited smaller volumes in all four PFC ROIs; however the effect was greater in right versus left hemisphere for SFG and for MFG. The correlations analyses showed young adults exhibiting negative associations between volumetric measures and activity levels for all PFC ROIs. Interestingly, in young adults, smaller right MFG volumes were related to greater right MFG activity and improved context memory performance. This was not observed in older adults. Older adults exhibited a positive association between PFC ROI volume and recognition accuracy, but the association between PFC ROI volume and activity was unclear.

H112

REGION-SPECIFIC REDUCTIONS IN HIPPOCAMPAL VOLUMES IN OLDER ADULTS ARE ASSOCIATED WITH DEFICITS IN SPATIAL AND TEMPORAL CONTEXT MEMORY RETRIEVAL Natasha Rajah[1], Jens Pruessner[1], Michelle Kromas[1], Jung Eun Han[1], Rafael Languay[1], David Maillet[1], Luc Valiquette[1]; [1]McGill University — Aging is associated with deficits in context memory retrieval (Rajah et al., 2009). FMRI studies have shown that encoding-related activity in the hippocampus (HC) is associated with subsequent successful context memory retrieval in young adults (Davachi et al 2003) and aging is associated with changes in the structure of HC (Head et al., 2008). Therefore, age-related changes in HC volume may contribute to the context retrieval deficits seen in older adults. In the current MRI study we used manual segmentation techniques to investigate how regional grey matter volumes of bilateral HC head, body and tail regions of interest (ROIs) differed between healthy young and older adults (Pruessner et al, 2001) and how regional HC volumes correlated with recognition vs. context memory performance within groups. Twenty-one young (mean age = 24.3) and 21 older adults (mean age 67.7) participated in this study. A Group (2) X HC ROIs (6) repeated measure ANOVA was significant, with post-hoc tests indicating a significant group difference between volumes of the right head and body of the HC ($p<.05$ corrected). Correlation analysis revealed that right head of HC was significantly correlated with memory performance on all tasks in young ($p<.05$), but not older adults. Significant correlation between left head and right body of the HC with context retrieval performance was also seen in young, but not older adults. In older adults, left head of the HC was correlated with item recognition alone. Implications of these results will be discussed.

H113

HIPPOCAMPAL CONTRIBUTION TO RETRIEVAL OF ITEM-CONTEXT ASSOCIATIONS: A DEVELOPMENTAL FMRI STUDY Dana DeMaster[1], Simona Ghetti[1]; [1]University of California, Davis — Our research investigates memory for details associated with the context in which an item was originally studied. In the present study, children age 8- to 11-years-old (n = 16) and adults (n = 14) participated in an fMRI study. In this two-task study, participants viewed drawings surrounded with a border of either green or red (the color association task) or viewed drawings presented either in the left or right side of the screen (the spatial association task). During fMRI data acquisition, participants completed a self-paced recognition test containing studied drawings and novel drawings. In the color association task participants indicated the color of the border within which the item was studied or that the item was thought to be novel. For the spatial association task, participants indicated the location where the item appeared during study or that the item was thought to be novel. Our behavioral results confirm age-related improvements in memory for item context in both the color association task and spatial location task. Age-related increase in item recognition is also observed in the color association task but not in the spatial location task. Our neuroimaging results provide preliminary evidence of age-related changes in the recruitment of the hippocampus for correctly remembered item context in both tasks. We predict that further analysis will show that activity in the posterior parahippocampal cortex is more associated with memory for spatial context than color context.

H114

THE POTENTIATION OF ASSOCIATIVE MEMORY BY POSITIVE AND NEGATIVE EMOTIONS: A ROSTROCAUDAL SPECIALIZATION WITHIN THE MEDIAL TEMPORAL LOBE David Luck[1,2], Marc Pelletier[3], Martin Lepage[1,2]; [1]University Institute in Mental Health, Douglas Research Centre, [2]McGill University, [3]CHU Sainte-Justine — Establishing associations between multiple information is essential for the formation of long-term memories, and is closely linked to the neuronal activity of the medial temporal lobe (MTL). However, it remains unclear how emotion affects memory for associations. Thus, this event-related fMRI study attempted to identify the neural correlates of the influence of positive and negative emotions on associative memory. Seventeen participants were scanned during the encoding phase. Participants were instructed to memorize 90 pairs of standardized pictures. Each pair was composed of a central scene and a peripheral unrelated object. Trials were either neutral, positive or negative according to emotional valence of the scene. In a subsequent associative recognition test, participants had to decide whether pairs were identical to the encoding phase or rearranged. At the behavioral level, participants exhibited better performance for both positive and negative trials relative to neutral trials. Within the MTL, a rostrocaudal dissociation of the parahippocampal gyrus (PHG) was observed, with greater bilateral activations for emotional trials in the anterior parts and greater activation for neutral trials in the posterior parts. In addition, emotional trials induced greater activations than neutral trials in the right amygdala, which was correlated with the right but not the left anterior PHG. This fMRI study suggests that both positive and negative emotions can promote efficient associative memory performance by enhancing activity in the right amygdala and anterior PHG. This study also provides some evidence for a rostrocaudal specialization within the medial temporal lobe regarding the emotional valence of associations.

H115

DOPAMINE MODULATION OF LEARNING WITH IMMEDIATE VS. DELAYED FEEDBACK: EVIDENCE FROM PARKINSON'S DISEASE Karin Foerde[1], Erin Kendall Brown[1], Nathan Clement[1], Daphna Shohamy[1]; [1]Columbia University — Multiple systems in the brain support different forms of learning and memory. Feedback-based, incremental learning of stimulus-response associations depends on the basal ganglia, whereas rapidly formed episodic memories of single-trial episodes depend on the medial temporal lobes (MTL). Emerging evidence suggests a critical role for dopamine in modulating both neural systems. However, fundamental questions remain about the behavioral consequences of dopaminergic modulation for different kinds of learning. We sought to address this question by testing the hypothesis that the presence and timing of response-contingent feedback is a critical factor driving learning to depend on one system or the other. To determine the role of dopamine in modulating both forms of learning, we tested individuals with Parkinson's disease either 'on' or 'off' dopaminergic medication. Patients and matched control participants engaged in trial-and-error associative learning task, wherein feedback was delivered either immediately or after a delay. We predicted that patients would be impaired at learning from immediate feedback but not from delayed feedback, and that dopamine modulation would impact both conditions. Results indicated that, overall, patients with Parkinson's disease were impaired when learning with immediate feedback but not when learning with delayed feedback. Furthermore, learning with immediate feedback was equally compromised in patients both on and off dopaminergic medication. By contrast, learning with delayed feedback was differentially affected by medication status. These results suggest that the basal ganglia are essential for learning from immediate but not delayed feedback. Modulation of dopamine, by contrast, impacts multiple forms of learning.

H116

BRAIN ACTIVITY DIFFERENCES BETWEEN SEDENTARY AND PHYSICALLY ACTIVE OLDER ADULTS DURING WORD RETRIEVAL: A CROSS-SECTIONAL FUNCTIONAL MAGNETIC RESONANCE IMAGING (FMRI) STUDY Zvinka Zlatar[1], Keith McGregor[1], Andrew Bauer[1], Stephanie Phan[1], Matthew Cohen[1], Bruce Crosson[1]; [1]University of Florida — With increasing age, humans experience cognitive decline and word retrieval problems which affect quality of life, thus investigating interventions to ameliorate age-related processes has become a crucial public health concern. The purpose of this study was to investigate brain activity differences of sedentary and active older adults as compared to younger adults during word retrieval. Ten self-reported physically active and nine sedentary old adults (ages 60-85), as well as ten young adults (ages 19-26) participated in this study. They underwent neuropsychological testing, a 12-minute treadmill test, fMRI, and were monitored for one week via self-reported activity questionnaires and accelerometer measures. A physical activity composite was created to confirm group assignment using distance traveled during the treadmill test, accelerometer data, and self-reported activity. The fMRI task was a blocked, covert word retrieval paradigm where participants saw a category and silently produced members until they saw the word 'stop' (e.g. birds: eagle, robin, owl…). This task was also performed overtly outside the MRI scanner to obtain the number and accuracy of words produced. We found that sedentary older adults activated a different network than old active and young adults during semantically-based word retrieval by differentially recruiting the non-task-dominant hemisphere and exhibiting attenuated posterior midline deactivations, all of which have been associated with age-related brain changes. It can be concluded that sedentary older adults may be more vulnerable to age-related brain activity changes than their active counterparts, and that physical activity may slow down age-related brain activity changes in older adults.

H117

FAILURE OF SPATIAL REPRESENTATION CONTRIBUTES TO MEMORY DECLINE DURING AGING Charlotte Russell[1], Stephanie Spencer[1], Paresh Malhotra[2]; [1]Brunel University, West London, UK, [2]Imperial College London, UK — It has been established that episodic memory deteriorates during normal aging. A critical component of accurate episodic memory for events and scenes is the correct recollection of spatial relationships both from one's own perspective and between individual items. A series of studies examined whether aging might differentially affect memory for these two forms of spatial information. Older (55-79 yrs) and younger participants (18–25 yrs) were asked to mentally construct to-be-remembered scenes from a number of different perspectives. The two groups did not differ in the ability to remember these scenes immediately after presentation, but when presented with photographic images after an interval period, older participants revealed a significant impairment. Older adults consistently failed to reject images being viewed from an alternative perspective. In contrast, further study revealed that between group performance is equivalent when inter-object relationships are manipulated. This specific impairment was more severe than older-to-younger group differences in standard word recall tests, revealing a particular inability to reliably recall self–perspective information. This deficit might underlie the development of unreliable memories as we age; without accurate spatial scene reconstruction from an egocentric point of view, episodic memories are likely to be less accurate and more vulnerable to error.

H118

THE INFLUENCE OF POST-TRAUMATIC STRESS ON HIPPOCAMPALLY-MEDIATED SPATIAL MEMORY John King[1], Isabella Foustanos[1], Chris Bird[2], Tom Hartley[3], Neil Burgess[2]; [1]Research Department of Clinical, Educational and Health Psychology, UCL, UK, [2]Institute of Cognitive Neuroscience, UCL, UK, [3]University of York, UK — Intrusive memories in PTSD have been explained in terms of anxiety-related impairment to the storage of hippocampally-mediated contextual information about the traumatic event. In the absence of stored context, sensory aspects of the event dominate in memory, manifesting as involuntary intrusive imagery (Brewin, 2007). Additionally, chronic stress associated with PTSD is hypothesised to result in organic damage to the hippocampus, possibly due to raised levels of cortisol (Bremner et al 2008). Prior memory studies of PTSD have suggested that PTSD involves verbal, but not visual, memory deficit. In contrast, we predicted that PTSD sufferers will show impaired performance on allocentric visuospatial memory tests, which have been demonstrated to depend on intact hippocampal functioning. We present data from a group of PTSD patients undertaking a novel test of spatial memory, the Four Mountains Task, which has been demonstrated to be sensitive to hippocampal damage (Hartley et al 2007). Data revealed a significant relationship between severity of PTSD symptomatology and performance. PTSD is commonly comorbid with depression, which also impairs explicit memory, but critically, for spatial memory the relationship persists when depressive symptomatology is factored out, suggesting that PTSD has a specific relationship with hippocampal memory impairment. These findings are consistent with the theoretical frameworks mentioned above, and are discussed in relation to a new neurobiologically informed model of traumatic memory (Brewin et al, in press), and in relation to therapeutic intervention.

H119

TRAINING ASSOCIATIVE ENCODING IN OLDER ADULTS: COSTS AS WELL AS BENEFITS? Kristin E. Flegal[1], Cindy Lustig[1]; [1]University of Michigan — Older adults often fail to self-initiate the deep, associative encoding processes that facilitate later memory and to activate the prefrontal regions that support such encoding. These deficits can be at least temporarily remediated with encoding instructions that encourage such processing (e.g., Craik & Byrd, 1982; Logan et al., 2002), making encoding processes an attractive target for cognitive training interventions. However, in addition to enhancing accurate memory for relevant items, increased associative encoding may increase susceptibility to false memory for related information. A relatively large (n > 85) sample of older adults (65-92 years) completed memory training under conditions that either a) mandated a semantic, associative encoding strategy (forming sentences that link to-be-remembered words), b) attempted to suppress such encoding by mandating rote rehearsal, or c) encouraged effort towards encoding (by enforcing study times) but allowed participants to choose their own strategies. On a surprise test for unstudied lures from the final training session, accuracy in the associative-encoding condition did not differ from chance, suggesting that strong associations between target items at encoding reduced lure processing at retrieval. For the rehearsal and strategy-choice conditions, larger training-task improvements correlated with better resistance to false memory in a post-training Deese-Roediger-McDermott task, but not for the associative-encoding condition. Instead, in the associative-encoding condition, poor lure recognition correlated with high susceptibility to false memory, suggesting that such encoding supports rejection of unrelated lures but impairs rejection of associated lures. These findings suggest that training to boost older adults' associative encoding has both benefits and costs.

H120

THE AGE EFFECTS ON THE NEUTRAL CORRELATES OF EPISODIC RETRIEVAL MODE: AN ERP STUDY Juan Li[1], Ting Zhou[1], Yanan Niu[1], Pengyun Wang[1]; [1]Center on Psychological Aging, Institute of Psychology, Chinese Academy of Science — OBJECT: Retrieval mode is a tonic cognitive state that is maintained while episodic retrieval is required. Event-related potentials (ERPs) were employed to investigate its neural correlates and age-related differences. METHODS: ERPs were recorded by a 64-channel Neuroscan system when young (n=15, mean age of 22.9 years old) and older subjects (n=14, mean age of 68.2 years old) performed retrieval tests. After a same study phase in which an animacy judgment was required to words, subjects were demanded to make episodic retrieval (new / living / nonliving judgment) and semantic retrieval (living / nonliving judgment) in two separate tests. The neural correlates of episodic retrieval mode were revealed by the contrast between the ERPs elicited by new words in these two tasks, since the new items per se were literally same except different instructions were applied to make judgment (episodic vs. semantic). RESULTS: 1) A greater positivity through the new-item ERPs contrast occurred 300ms after stimulus onset and restricted in PFC areas, which were sustained during whole retrieval course, independent of explicit memory performance and with absence of age-related differences, may representing one kind of automatic-based processes. 2) Another larger positivity occurred later (600-900ms in the young, 900-1200ms in the old) with a broader scalp distribution, and showed robust age-related differences and significant correlations with explicit memory performances, may denoting a relatively high-controlled processes. CONCLUSION: The results suggested that there may be two cognitive components in retrieval mode processes associated with divergent aging effects and dissociate correlations with explicit memory ability.

H121

BRAIN VOLUME CHANGES IN SUCCESSFUL AGING Selam Negash[1,2], Jeremiah Aakre[2], Stephen Weigand[2], Glenn Smith[2], Shane Pankratz[2], Yonas Geda[2], David Knopman[2], Bradley Boeve[2], Rosebud Roberts[2], Rober Ivnik[2], Clifford Jack[2], Ronald Petersen[2]; [1]University of Pennsylvania, [2]Mayo Clinic, Rochester — The goal of the present study was to determine whether MRI measurements can differentiate between successful aging and typical aging. The project drew upon a community-based cohort of healthy individuals recruited in the Mayo Clinic Alzheimer's Disease Patient Registry (ADPR). Successful aging was defined using subtests in four cognitive domains: memory, attention/executive function, language, and visual-spatial skills. A global z-score was generated from the four cognitive domains, and subjects with mean global z-score in the top 10% were classified as "successful agers" whereas those in the remaining 90% were classified as "typical agers". Participants who had all the neuropsychological data needed to generate criteria for successful aging were selected, and there were 560 such participants. Of those, 125 subjects who had had Magnetic Resonance Imaging (MRI) of the head constituted the sample for this study. Each MRI scan was graded for hippocampal volume and ventricular size on 3D T1 weighted images. Results showed no significant differences in hippocampal volume (p= 0.2) or ventricular volume (p = 0.3) between successful agers and typical agers. This suggests that, in comparing individuals aging successfully to those aging normally, brain volume differences are minimal and unlikely to account for the performance differences observed between the two groups.

H122

EVENT CONGRUENCY AND EPISODIC ENCODING: A DEVELOPMENTAL FMRI STUDY Anat Maril[1], Rinat Avital[1], Niv Reggev[1], Liat Ben Sira[2], Neta Livneh[1]; [1]The Hebrew University of Jerusalem, [2]Tel Aviv University, Tel Aviv Sourasky Medical Center, Dana Children's Hospital — A main known contributor to adults' superior memory performance compared to children's is their differential reliance on existing knowledge-base: compared to adults, children's semantic networks are less accessible and less established. Using the "congruency effect", we manipulated the encoded stimuli in the present experiment such that the use of knowledge-base at encoding was more, or less, accessible, in both children and adults. Adults' fMRI studies of the congruency effect target a priori regions of interest for a developmental comparison – the Prefrontal cortex (PFC) and the medial-temporal lobe - as they are known to undergo prolonged anatomical and/or organizational development. While being scanned, children (ages 8-11) and young adults (current N=24) saw printed noun / color combinations, and were asked to indicate whether each combination existed in nature. A subsequent recognition test was administered outside the scanner. Behaviorally, both age groups showed the congruency effect, but importantly, while adults showed the usual memory advantage for the congruent nouns, children's memory was similar to adults' for the incongruous ones. Children's congruency-related activation was observed in medial inferior parietal regions, while the adults' occupied medial and left lateral frontal cortices. Subsequent memory analysis revealed a region in the left inferior frontal cortex in both age groups; in the children group, an additional large medial parietal region was also observed in this contrast. Results point to different patterns of activation for congruency processing between adults and children, as well as similar regions in the PFC that support episodic encoding of congruent items.

H123

CORTISOL LEVELS IN RESPONSE TO STRESSFUL VERSUS NON-STRESSFUL TESTING ENVIRONMENTS Shireen Sindi[1,3,5], Catherine Lord[6,7], Bruce Pike[1,2], Jens Pruessner[1,2,3], Sonia Lupien[4,5]; [1]McGill University, [2]Montreal Neurological Institute, [3]Douglas Mental Health University Institute, [4]University of Montreal, [5]Centre de Recherche Fernand Seguin, [6]McMaster University, [7]Women's Health Concerns Clinic — Elevated cortisol levels can impair cognitive performance, but do testing environments themselves function as stressors? The goal of this study was to assess whether the cortisol stress response (CSR) differs as a function of testing environments manipulated to induce higher or lower distress. As part of a larger study, twenty eight adults ages 18 to 35 were each tested in three different conditions: 1) Montreal Neurological Institute (MNI - Low stress) tested on university grounds in the afternoon by a young graduate student; 2) Douglas Hospital (DH -High stress) tested far from the university in the morning by an older adult; 3) Douglas Hospital re-visit (DH-R - High stress) for exposure to a psychosocial stress task. Salivary cortisol was repeatedly measured in all conditions. To test whether different testing environments are stressful, we calculated Area Under the Curve with respect to ground (AUCg) was calculated for the CSR in each session. One-way repeated measures ANOVA were performed with three levels for the different contexts followed by paired samples t-test for significant effects. Results revealed that DH AUCg was significantly higher than the MNI AUCg. DH-R AUCg was also significantly higher than MNI AUCg. That healthy young adults experienced higher CSRs in both stressful conditions (morning testing) versus the non-stressful condition (afternoon testing) stresses the importance of context when testing cognitive performance. Our findings hold important implications for studies testing populations which may be more sensitive to the testing environment, such as patients with certain mental health conditions and older adults.

H124

AGE-DEPENDENT MEMORY IMPAIRMENTS FOLLOWING TRANSIENT GLOBAL ISCHEMIA: RELATIONSHIP TO HIPPOCAMPAL PATHOLOGY Carl J. A. Bourdage[1], Dave G. Mumby; [1]Concordia University — Most human stroke victims are part of an older population while most animal models of ischemia employ young adult rodents. To add generalizability to rodent models of global ischemia, and its associated neuropathology and memory impairments, to the human stroke population, this study examines the effect of a 15-min global ischemia via four vessel occlusion in rats that were 8-weeks and 50-weeks of age. Rats were tested for object-location memory, using a 24-hour retention delay and object-recognition memory, using 15-min and 24-hour delays. Rats with sham-ischemia in all age groups showed a preference for the moved object during the novel-object-in-place test of spatial memory, and for the novel object during the 15-min and 24-hour novel-object-preference (NOP) test. Rats that received ischemia displayed impairments in all age groups in the spatial memory test. However, only the 50-week group displayed impairments in the 24-hour NOP test of object recognition. Ischemic rats in all age groups had significantly fewer cells in the CA1 and hilus subfields of the hippocampus, than did sham-ischemia controls. Only the 50-week ischemia group had significant damage in CA3 and the dentate gyrus. Performance in the NOIP test was correlated with cell counts in CA1 and the dentate gyrus, however no relationship was found between cell counts of the hippocampus and performance in the NOP test. These findings indicate that the severity of memory impairments and neuropathology due to ischemia are influenced by the age of the brain and support the concept of distinct memory systems in the rat.

H125

MIDLIFE IMPROVEMENT IN COGNITIVE ABILITIES IS RELATED TO OPENNESS TO EXPERIENCE Anne L. Richards[1], Tara Madhyastha[1], Paul R. Borghesani[1], K. Warner Schaie[1], Sherry L. Willis[1]; [1]University of Washington — Our goal was to determine how change in various cognitive abilities during midlife (age 46-53) relates to midlife personality. We also investigated whether personality is related to brain volume of regions associated with cognitive abilities. Openness to Experience is one trait from the Five-Factor model of personality and relates to being receptive to new experiences and ideas. We validated our measure of Openness by relating it to daily activities using the Moos scale of home and work environment (N=321). We found several correlations with openness, including expressitivity (r=.147, p=.008), intellectuality (r=.142, p=.011), and active recreation (r=.192, p=.001) in home environment, and control (r=.234, p<.000), innovativeness (r=.276, p<.000) and autonomy(r=.176, p=.002) in work environment. We retrospectively categorized participants from the Seattle Longitudinal Study according to executive and memory ability changes in midlife. The categories were gainers (whose cognitive ability improved during midlife), decliners (whose cognitive ability worsened during midlife), and stables (everyone else). General Linear Model (GLM) analysis showed that executive ability groups differed in Openness (N=979, df=2, F=5.601, p=.004) as did memory ability groups (N=979, df=2, F=3.392, p=.034). Gainers in both cognitive abilities scored highest on Openness. MRI data from 145 participants showed that Openness correlated with left hippocampal volume (r=.220, p=.008) but did not correlate significantly with volume of segments within a prefrontal cortex slab. These preliminary findings show evidence that changes in cognition in midlife are related to personality. Future work will continue to examine the relationship between midlife change in cognitive ability, personality, and brain structure.

H126

FEEDBACK-BASED LEARNING AND GENERALIZATION IN YOUNGER AND OLDER ADULTS Erin Kendall Braun[1], Karin Foerde[1], Kate Johnson[1], Nathan Clement[1], Daphna Shohamy[1]; [1]Columbia University — Throughout the course of healthy adult aging, the capacity for learning is dampened. However, questions remain about how aging affects specific cognitive processes during learning. Guided by neurobiological evidence for an age-related decline in dopamine transmission, we sought to assess how aging impacts two different aspects of learning: (a) Learning from feedback, which depends on dopamine modulation of the striatum; (b) Generalization of learned knowledge, which depends on the hippocampus and may also be modulated by dopamine. To understand how feedback-based learning and subsequent generalization are affected by healthy aging we used a two-phase learning and generalization paradigm with healthy young adults (18- to 30-years) and older adults (50- to 85-years). In the first phase, participants used trial-by-trial feedback to learn a series of associations. In the second phase, participants were asked to generalize what they learned to novel stimulus combinations. We found that older adults made many more errors during learning (on average more than 10 times the number of errors of the younger adults), indicating an impaired ability to use feedback to drive learning. Independent of this learning impairment, we also found that a subset of the older adults failed to generalize what they learned. These findings suggest that aging impacts multiple independent learning processes that may be accounted for by age-related changes in dopamine transmission of multiple different learning systems.

H127

ERP INDICES OF EPISODIC AND SEMANTIC MEMORY DEFICITS IN PATIENTS WITH AMNESTIC MILD COGNITIVE IMPAIRMENT (AMCI) Patric Meyer[1], Michael Hoppstaedter[2], Michèle Wessa[1], Lutz Froelich[1], Johannes Schroeder[3], Andrea V. King[1], Herta Flor[1]; [1]Central Institute of Mental Health, Mannheim, Germany, [2]Experimental Neuropsychology Unit, Saarland University, [3]Section of Geriatric Psychiatry, University of Heidelberg, Germany — Dual process models of recognition memory assume that recognition judgments are subserved by recollection and familiarity. Moreover, neuroimaging and neuropsychological data have supported an anatomic dissociation within the medial temporal lobes with respect to these processes. Recollection has been linked to hippocampal function while familiarity appears related to rhinal cortices. Interestingly, even at a pre-dementia clinical stage, significant pathology is present in the mesio-temporal lobe in patients with aMCI which has been conceptualized as a transitional state from normal aging to clinical Alzheimer's disease (AD). Several investigations showed that familiarity-based memory, as opposed to recollection, appears largely intact in healthy aging. Thus, familiarity, perhaps as a marker of rhinal integrity, may be a specific measure for differentiating those with very early AD pathology from those with memory decline due to 'normal' aging. This should also hold for semantic processing - as expressed in the N400 - which has also been associated with rhinal functioning. The present study sought to evaluate recollection, familiarity and semantic processing and their electrophysiological correlates in aMCI by means of event-related potentials. Patients with aMCI and age- and education-matched controls were tested on a recognition memory and a semantic priming paradigm. Preliminary data show that in aMCI familiarity was impaired to at least the same extent as recollection and that semantic processes were significantly delayed. Especially, the apparent sparing of familiarity in aging suggests that the impairment of processes mediated by the rhinal cortex may offer a relatively specific marker for early AD.

H128

EVERYDAY MEMORY ERRORS IN OLDER ADULTS: FREQUENCY AND ASSOCIATION WITH COGNITIVE MEASURES Lynn Ossher[1], Kristin E. Flegal[1], Cindy A. Lustig[1]; [1]University of Michigan — There are many laboratory studies documenting age differences in memory, and these differences are an important target for many cognitive training programs. However, very little is known about which memory problems are most commonly experienced by older adults in their everyday lives outside of the lab, or how those problems relate to laboratory-based cognitive measures. In this study, a relatively large (n > 90) sample of healthy older adults (65 – 92 years) completed the Everyday Memory Questionnaire (EMQ; Sunderland et al., 1983), standardized cognitive and questionnaire measures, and several laboratory memory tasks. Higher reports of errors on the EMQ were negatively associated with scores on the Mini Mental Status Exam (Folstein et al., 1975) and the Extended Range Vocabulary Test (Educational Testing Services, 1976), but did not correlate with age or education. The most commonly reported memory errors were speech-related. Errors related to speech and to learning new things correlated with subscales of the Memory Self-Efficacy Questionnaire (Berry et al., 1989), and a higher score on the Need for Cognition Scale (Cacioppo et al., 1984) was associated with fewer memory errors in learning new things. Effects were modified by gender. The data acquired provide a basis for factor analysis of the EMQ, as previously carried out using other populations. The results suggest that memory errors experienced by older adults in daily life are largely verbal, associated with other cognitive measures, and may be different for men and women.

H129

AN N400 STUDY OF RISKY SENTENCE PROCESSING IN ADOLESCENTS Jill Grose-Fifer[1], Steven Hoover[1], Andrea Rodrigues[1], Tina Zottoli[1], Sheyla Celin[1]; [1]John Jay College of Criminal Justice, City University of New York — Despite an increasing facility to reason analytically, adolescents frequently engage in risk-taking behaviors that are potentially harmful. Avoidance of risky situations is aided by rapid access to semantic networks that alert one to danger. The goal of this study was to investigate whether the organization of these networks is immature in adolescence. World knowledge and long-term memory content can modulate the N400 priming effect. Therefore, an N400 sentential priming paradigm was used to compare risky, predictable and incongruent sentence processing in adolescents and adults. Our results suggest that adults and adolescents process predictable sentences in a similar way, as evidenced by equivalent N400 priming in comparison to the incongruent condition. However, in adults, more activation is required to access final words in a risky sentence than when the situation is more predictable and benign. This is evidenced by a larger N400 to the final word in a risky sentence compared to that in a predictable sentence. Furthermore, in adults there was no difference between the N400 to a risky sentence and that elicited by an incongruent sentence ending. In contrast, adolescents showed little difference between the N400 generated in the risky condition and that elicited by expected sentences. This indicates that the risky scenario final words were unexpected for adults but not for adolescents. The data suggest that teenagers have different semantic memory organization for risky sentences compared to adults. This may help to explain why teenagers engage in risky activities when there is little time for deliberative thought.

Executive Processes: Goal Maintenance & Switching

H130

IMPAIRED MEANING ACCESS DURING TASK SWITCHING: EVIDENCE FROM THE SUPPRESSION AND POSTPONEMENT OF THE N400 UNDER MULTITASKING Francois Vachon[1,2], Pierre Jolicoeur[1]; [1]Universite de Montreal, [2]Universite Laval — The cognitive system is able to reconfigure mental resources flexibly to adapt to new a task. While task switching is known to be detrimental on behavioral performance, there is a dearth of studies concerned with the exact locus of task switching on the processing of target stimuli. We measured event-related potentials to explore the neural consequences of task switching on semantic processing. Using two well-known dual-task paradigms—the attentional blink and the psychological refractory period paradigms—we examined the context-sensitive N400 component evoked by the second of two target words under conditions that involved either a task switch or no switching. Whereas the N400 was unaffected by the temporal distance separating the targets in the absence of switching, it was delayed and strongly attenuated, if not completely suppressed, in the switch condition when the targets occurred in rapid succession. This was true whether the first task required the first target to be processed at a lower, perceptual level (with no N400 triggered by the first target) or at a higher, semantic level (where the first target evoked an N400). These findings suggest that task switching imposes strong processing limitations as it momentarily prevents meaning extraction. Moreover, by showing that the presentation of a word at fixation is not sufficient for eliciting an N400, the present results provide further evidence for the nonautomaticity of semantic processing of words.

Language: Development & Aging

I1

BETRAYED BY THE VOICE: HOW PARKINSON'S DISEASE AFFECTS IMPRESSIONS OF PERSONALITY AND SOCIAL COMPETENCE Abhishek Jaywant[1], Marc D. Pell[1]; [1]McGill University — In Parkinson's disease (PD), basal ganglia dysfunction and accompanying motor signs frequently lead to impairments in speech production and communication. Importantly, motor deficits and alterations to the speaking voice may contribute to changes in how Parkinsonian speakers' linguistic and social competence is viewed from the perspective of listeners. To test this hypothesis, thirty listeners unaware of speakers' disease status listened to discourse recordings produced by 18 non-demented PD speakers and 17 healthy controls (HC). Using linear rating scales, listeners rated each discourse sample on several dimensions of personality and linguistic competence. Acoustic characteristics of the discourse recordings were analyzed and correlated with listener ratings. The results demonstrated that PD speakers were rated as significantly less happy, friendly, interested, and involved compared to HC speakers. These negative social impressions were related to speech intensity (volume) and temporal characteristics (dysfluencies such as increased pause length and pause time). However, the negative impressions of PD speakers were not influenced by the linguistic content of speech because their discourse was perceived as coherent, comprehensible, organized, and unimpaired overall. Our findings indicate that listeners use vocal cues to infer social and personality characteristics of speakers, and that due to motor limitations in the speaking voices of PD patients, listeners arrive at potentially erroneous impressions of Parkinsonian speakers that may not reflect their underlying socio-emotional state.

I2

BRAIN CORRELATES OF AGE-RELATED COGNATE AND NON-COGNATE LEARNING Daniel Adrover-Roig[1], Karine Marcotte[1,2], Gaëlle Raboyeau[1], Ana Inés Ansaldo[1,2]; [1]Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal, Canada, [2]Faculté de Médecine, Université de Montréal, Canada — Goals. We investigated the neural correlates of second-language lexical learning, regarding age, learning phase, and word type in French-speaking young and elderly participants who learned Spanish cognates and non-cognates by means of a computer program. Methods. Participants performed an overt naming task during er-fMRI scanning at an early learning phase and after consolidation of word learning. Results. At the early phase, younger adults were more accurate than the elderly, being this most evident with non-cognates, which induced more non-responses. A full factorial analysis showed cognate naming to trigger activations in the left anterior cingulate (ACC), whereas non-cognates significantly activated the left cerebellum, the occipital cortex bilaterally, the right ACC, the right fusiform, superior temporal, and right frontal gyri. The activity in the right insula reflected non-cognate early processing. The early phase showed bilateral frontal, bilateral cerebellar and right caudate activations, whereas at consolidation significant activations were constrained to the postcentral gyri. Older adults significantly activated more posterior bilateral areas than younger adults, particularly when naming non-cognates. Further, they showed larger right frontal and bilateral temporal activations than the younger when naming them at the early phase. Conclusions. Overlapping lexical representations (cognates) are processed faster and entail interference control (ACC); non-cognate naming encompasses maximal articulatory effort at the early phase (right insula). In comparison to the young, older adults rely more upon visual processing, and engage executive and semantic processing areas, particularly during the early phase of non-cognate learning.

I3

AGE-RELATED DIFFERENCES IN RESOLVING A SYNTACTIC AMBIGUITY: EVIDENCE FROM FMRI Delani Gunawardena[1], Corey McMillan[1], Vanessa Troiani[1], Murray Grossman[1]; [1]University of Pennsylvania — Left inferior frontal cortex (IFC) and left posterolateral temporal cortex (PLTC) are often implicated in a core sentence processing network. Healthy seniors may need to upregulate regions beyond this network. We used fMRI to investigate age-related differences in ambiguous sentence processing. We tested 13 young adults and 14 healthy seniors using a passive moving-window reading task. The verb in all sentences preferred a direct-object structure. Half had a "more compatible" structure, where the verb was followed by a direct object (e.g. "The mayor heard the election result on the radio"). Half had a "less compatible" structure, where the verb was followed by a sentential complement (e.g. "The mayor heard the election result was fixed"). We also assessed working memory (WM) using a reading span task. A subgroup of seniors had equal WM performance as young adults (Good-WM; n=7). Another subgroup had significantly poorer WM (Poor-WM; n=7). Our analyses compared the ambiguity resolution phrase across groups for less compatible versus more compatible stimuli. Young adults activated left PLTC compared to Good-WM consistent with a core sentence processing network. Good-WM recruited right IFC relative to young adults. A comparison of Poor-WM relative to Good-WM and young adults revealed no significant activation. Even though biological changes associated with aging may yield diminished neural resources, seniors with good WM may recruit right IFC to support the processing demands required for comprehending syntactically ambiguous sentences. Seniors with diminished WM resources are not able to upregulate regions and therefore may have limitations in comprehending ambiguous sentences.

I4

FROM FUNCTIONAL BRAIN MAPPING TO GENETIC MAPPING: GENETIC DETERMINANTS OF FUNCTIONAL CEREBRAL ASYMMETRY DURING READING Philippe Pinel[1,2,3], Fabien Fauchereau[4,5], Antonio Moreno[1,2,3], Jean-Baptiste Poline[2], Alexis Barbot[6], Thomas Bourgeron[4,5], Stanislas Dehaene[1,2,3,7]; [1]INSERM, U562, Cognitive Neuroimaging Unit, France, [2]CEA, DSV/I2BM, NeuroSpin Center, France, [3]Paris-Sud University, IFR49, France, [4]Institut Pasteur, Paris, France, [5]Paris VII University, France, [6]IMAGEN, 6th Framework European Research Project, France, [7]Collège de France, Paris, France — While reading ability essentially relies on culture and education, familial aggregation of a reading specific developmental disease (dyslexia) suggested that its cerebral correlates are under strong genetic influences. Some of these genes were recently isolated from association with dyslexic cohorts. However, effects of these genes onto the reading cerebral circuit have never been reported. Using a functional magnetic resonance imaging (fMRI) / genetic database of one hundred healthy subjects, we first illustrated the effects of the genetic polymorphism onto the cerebral functional asymmetry during a reading task along the most well know gene associated with reading performance: KIAA0319. Our result showed for the first time that single nucleotide polymorphisms (SNPs) previously associated to a risk of dyslexia are also associated with a lower degree of functional asymmetry in the superior temporal cortex in healthy population. Second, we used the same method and endophenotype for hunting genes onto genetic candidate areas (chromosomes 2, 3, 6, 15 and 18). This exploratory approach allowed us to draw up the map of the genetic determinants of the functional asymmetry during reading. Importantly, our results overlap with some of the genes already associated to dyslexia (ROBO1), but also help to refine the description of the published dyslexia susceptibility loci, distributed along almost 2% of the genome. This work illustrates the feasibility and the potential of exploring jointly the functional and the genetic dimensions of a complex human cognitive capacity, and point out new genetic hotspots that should be investigated by geneticists in the near future.

I5

PROSODY IS THE KEY: ERP STUDIES ON WORD SEGMENTATION IN 6 AND 12-MONTH-OLD GERMAN INFANTS Claudia Männel[1], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Most speech directed towards infants consists of multiword sentences. Thus, before lexical-semantic learning can take place infants have to segment individual words from continuous speech. Previous studies have shown that between 7.5 and 10 months, infants begin to recognize sentence-embedded words, when previously familiarized with these words in isolation (e.g., Jusczyk, Houston, & Newsome, 1999; Kooijman, Hagoort, & Cutler, 2005). These studies indicate that infants start to segment familiarized words from continuous speech at around 7 months. In the current ERP studies, we investigated word segmentation following infants' natural environment by presenting whole sentences during familiarization. We explored the impact of prosody on infants' word segmentation abilities by using infant-directed speech with or without accent on the words to be familiarized. Six- and 12-month-olds listened to blocks of eight different sentences each containing the same low-frequency bisyllabic word. Each block was followed by four test tokens of the familiarized and a new word. During test, ERPs of 6-month-olds revealed differences between word types, but only for those words that had been prosodically marked during familiarization. This indicates that even 6-month-olds are able to segment words from sentences, but only when these words are prosodically accentuated. For 12-month-olds, who showed word segmentation independent of prosodic realization, prosody still facilitates word recognition as indicated by more negative ERP responses to previously accentuated words than non-accentuated ones. In conclusion, the current data emphasize the crucial role of prosody in infants' early arising ability to segment words from continuous speech.

I8

EYE MOVEMENTS IN YOUNG GERMAN DYSLEXIC CHILDREN: WORD LENGTH AND WORD FREQUENCY EFFECTS Alexander N. Sokolov[1], Ute Dürrwächter[1], Jens Reinhard[1], Gunther Klosinski[1], Susanne Trauzettel-Klosinski[1]; [1]University of Tübingen, Germany — We combined orthogonally the word length and word frequency to examine if the difficulty of reading material affects eye movements in readers of German, which has high orthographic regularity, comparing the outcome with previous findings available in other languages. Sixteen carefully selected young German speaking dyslexic children (mean age 9.5 years) and 16 age-matched controls read aloud four lists, each comprising ten unrelated words. The lists varied orthogonally in word length and word frequency: high-frequency, short; high-frequency, long; low-frequency, short; low-frequency, long. Eye movements were measured using a scanning laser ophthalmoscope (SLO). In dyslexic children, fixation durations and the number of saccades increased both with word length and word frequency. The percentage of regressions was only increased for low-frequency words. Most of these effects were qualitatively similar in the two groups, but stronger in dyslexic children, pointing to a deficient higher-level word processing, especially phonological deficit. The results indicate that reading eye movements in German children are modulated by the degree of difficulty, and orthographic regularity of the language can determine the nature of modulation. The findings suggest that similar to Italian but unlike English readers, German children prefer indirect sub-lexical strategy of grapheme phoneme conversion.

I9

PRESCHOOL CHILDREN INTERPRETING TOPICALIZED OBJECTS: NEURAL CORRELATES OF THEIR BEHAVIORAL PERFORMANCE Christine S. Schipke[1,2], Regine Oberecker[1], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Berlin School of Mind and Brain, Berlin, Germany — Adults do not show any differences in their event-related potentials (ERP) when processing case marked topicalized object noun phrases in German sentences (object/accusative before subject/nominative) compared to the canonical word order (subject/nominative before object/accusative) (Frisch & Schlesewsky, 2005). Here, we investigated the development of case marking and word order processing for the interpretation of argument structures in preschool children. We conducted an ERP study with children at the age of 3, 4;6 and 6 years. In addition, we tested the same children behaviorally in a sentence-picture matching task. Word order and case marking were manipulated in main clauses including transitive verbs and noun phrases referring to animate arguments. Behavioral data showed a significant increase in the correct response to the subject-first condition between 3 and 4;6 years. A significant improvement for the processing of object-first pictures, however, occurs only between 4;6 and 6-year-olds. The present ERP results give detailed insights into the neural mechanisms underlying this development: 3-year-olds do not differ in the processing patterns of object-first vs. subject-first sentences, children at the age of 4;6, however, display an early frontocentral negativity for the object-first condition. In contrast, 6-year-olds show a late positivity in response to the same stimuli. These findings suggest that 4-year-olds, unlike 3-year-olds, detect differences in the two sentence structures indicated by a scrambling negativity for case marked topicalized objects. The positivity in 6-year-olds, which reflects syntactic integration processes, together with the behavioral results indicate that only these children start to accomplish the comprehension of object-first sentences.

I10

ITALIAN GRAMMAR LEARNING IN GERMAN BABIES Regine Oberecker[1], Jutta L. Mueller[1], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences — The structure of any natural language crucially requires the acquisition of dependencies between non-adjacent elements (AXB) for which the underlying rules are complex. We tested whether 4-month-old German infants can learn and track non-adjacent dependencies (AXB) in a novel language (Italian) to which they were exposed only during the experiment. The stimulus material consisted of natural Italian sentences containing dependencies between non-adjacent elements (i.e., the auxiliary and the suffix of the following verb: sta X-ando, può X-are). During four learning phases the infants were familiarized with correct sentences (e.g. sta X-ando, può X-are). Interspersed between the learning phases, there were four test phases containing correct and incorrect sentences (e.g. sta X-are, può X-ando). The ERPs to the verb and its suffix were averaged across the four test phases to reveal the grammaticality effect. The brain activation indicates a more positive-going wave in response to grammatically incorrect compared to correct sentences. In order to demonstrate that the observed positivity occurred due to learning within the experiment, we compared the first test phase to the average of the last test phase. While no ERP difference for correct and incorrect sentences can be detected in Test Phase 1 a significant difference can be seen in Test Phase 4. The finding indicates that the observed positivity for the processing of the syntactically incorrect sentences occurred due to infants´ learning structural dependencies across the four learning phases during the experiment.

I11

EFFECTS OF LANGUAGE PROFICIENCY ON EVENT-RELATED BRAIN POTENTIALS IN SCHOOL-AGE CHILDREN Amanda Hampton Wray[1], Christine Weber-Fox[1]; [1]Purdue University — Proficiency in expressive and receptive language has been shown to affect event-related brain potentials (ERPs) in both monolingual and bilingual adults (Pakulak & Neville, in press; Weber-Fox, et al., 2003; Weber-Fox & Neville, 1996). However, little is known about the relationship between language proficiency and ERPs in young school-age children who display normal language abilities. In this study, measures of expressive and receptive language proficiency, reading ability, and verbal working memory were obtained for normally developing second-graders. The children were categorized as demonstrating either "high" or "normal" language proficiency. ERPs were collected while children made judgments of correctness about natural speech sentences containing semantic anomalies ("The fireman breaks the soup with his hammer") or phrase-structure violations ("The fireman breaks the glass with this his hammer"). Semantic anomalies elicited smaller amplitude N400s in the high-language children compared to the children with normal-language proficiency. Additionally, phrase-structure violations elicited larger amplitude anterior negativities and P600s in the children with high language abilities, consistent with findings in young adults (Pakulak & Neville, in press). These findings suggest that children with above-average language abilities may be less reliant on contextual information for sentence processing and process syntactic information more efficiently. The current study provides evidence of a continuum for semantic and syntactic processing among typically developing children that goes beyond the distinction of normal and language impaired groups, and highlights the need to consider the impact of varying language abilities, even in the normal range, on the interpretation of neural processes elicited for language tasks.

I12

DEVIATIONS IN THYROID HORMONE LEVEL DURING EARLY DEVELOPMENT CAUSE LOCALIZED ABNORMALITIES IN CORTICAL DEVELOPMENT ASSOCIATED WITH IQ, LANGUAGE AND MEMORY IMPAIRMENTS. CVVV XDXVCDDDVCV Jurgen Germann[1,2], Karen Willoughby[2], Jason Lerch[1,2], Joanne Rovet[2]; [1]The Mouse Imaging Centre, [2]The Hospital for Sick Children, Toronto, Canada — Thyroid hormone (TH) is essential for early brain development and in the first half of pregnancy, is derived from the maternal thyroid supply and in the second half, from both maternal and fetal supplies. Thus if either of these sources is insufficient, abnormal brain development will occur. Several conditions involving reduced TH availability during pregnancy are maternal hypothyroidism (Hypo); treatment for maternal hyperthyroidism (Hyper); and congenital hypothyroidism (CH). While each of these conditions contributes to adverse neurocognitive sequelae –different among conditions- their specific effects on the brain development are unknown. The present study investigated possible changes in cortical development and their relationship with measures of cognitive ability in 10-12 year old children from the three TH-deficient groups using a MRI measure of cortical thickness, which has been shown to be sensitive to developmental changes and often altered with abnormal development. Results indicated that compared to normal controls, TH-deficient children had localized cortical thickness abnormalities in 12 areas throughout the left hemisphere. Additionally, these localized signs of developmental abnormalities were correlated with cognitive measures in which TH-deficient children were significantly impaired: the anterior cingulate (memory), frontal pole (verbal memory), temporal pole (IQ), posterior insula (IQ), pars opercularis (language), pars triangularis (memory), Heschl's gyrus (memory), parahippocampal gyrus (memory), precuneus (IQ), supramarginal gyrus (verbal memory), middle frontal gyrus (verbal memory and IQ), and caudal orbitofrontal cortex (memory). The results of this study give new critical insight into possible local developmental changes caused by abnormal TH levels during early development and associated behavioral impairments.

I13

PROCEDURAL LEARNING DEFICITS IN CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT Martina Hedenius[1,2], Antoine Tremblay[2], Cristina D. Dye[2], Margareta Jennische[1], J. Bruce Tomblin[3], Michael T. Ullman[2]; [1]Unit for Speech and Language Pathology, Uppsala University, Sweden, [2]Brain and Language Lab, Georgetown University, [3]Child Language Research Center, University of Iowa — Specific Language Impairment (SLI) is a developmental disorder that affects language, in particular grammar. However, the disorder is also associated with deficits of non-linguistic functions such as motor skills. The Procedural Deficit Hypothesis (PDH; Ullman & Pierpont, 2005) proposes that SLI can be largely explained by abnormalities of brain structures that constitute the procedural memory system. This system, which is rooted in frontal/basal-ganglia circuits, seems to be specialized for the implicit learning of rules and sequences, in both motor and cognitive domains, including grammar. The PDH predicts deficits at learning in procedural memory. We tested language-impaired (N=31, mean age=10) and typically-developing (N=31; mean age=10) children on a non-language procedural learning task, the Alternating Serial Reaction Time task (ASRT; Howard & Howard, 1997). This differs from the classic Serial Reaction Time task in that the pattern sequence is interspersed with random stimuli, thus allowing the examination of a continuous learning curve. Mixed-effects regression analyses indicated that typically-developing children quickly learned the sequence, whereas the language-impaired children showed no learning at all. Various potentially confounding variables were matched between the groups and/or statistically controlled for, including age, sex, handedness, performance IQ (PIQ). The results support the PDH. Additionally, PIQ did not predict learning (in either group); because the language-impaired subjects were distributed both above and below the PIQ cut-off (85) typically used for differentiating children with SLI from children with Non-specific Language Impairment (NLI), this result strengthens the view that SLI and NLI are not distinct disorders.

I14

NEURAL BASIS OF PHONOLOGICAL TRAINING IN LOGOGRAPHIC WRITTEN SYSTEM Yuan Deng[1], James Booth[2], Tai-li Chou[3], Guo-sheng Ding[4], Dan-ling Peng[4]; [1]Institute of Psychology, Chinese Academy of Sciences, Beijing, P. R. China, [2]Northwestern University, Evanston, IL, [3]National Taiwan University, Taiwan, [4]Beijing Normal University, Beijing, P. R. China — Neural changes related to learning of the pronunciation of Chinese characters in English speakers were examined using functional magnetic resonance imaging (fMRI). We examined item specific learning effects for trained characters, and the generalization of phonetic knowledge to novel transfer characters that shared a phonetic radical (part of a character that gives a clue to the whole character's pronunciation) with trained characters. Behavioral results showed that shared phonetic information interfered with accuracy for trained characters but improved performance for transfer characters. Neuroimaging results found a significant learning effect for trained characters in bilateral lingual gyrus and the learning effect in left inferior frontal gyrus (BA 44) correlated with behavioral improvement. Moreover, the activation at late stage of training in these two regions for the transfer characters was correlated with knowledge of the phonetic radical in a delayed recall test. The current study suggests that bilateral lingual gyrus and left inferior frontal gyrus are crucial for learning of Chinese characters and generalization of that knowledge to novel characters. Inferior frontal gyrus is likely involved in phonological segmentation, whereas bilateral lingual gyrus may subserve processing visual information regarding the phonetic radicals.

I15

AMYGDALA VOLUME IN INFANCY RELATES TO SPECIFIC LANGUAGE ABILITIES AT 5 YEARS OF AGE Silvia Ortiz-Mantilla[1], Myong-sun Choe[2,3], Judy Flax[1], P. Ellen Grant[3,4], April A. Benasich[1]; [1]Center for Molecular & Behavioral Neuroscience, Rutgers, The State University of New Jersey, [2]Center for Morphometric Analysis, Pediatric Neurology, MGH at Harvard Medical School, [3]Fetal-Neonatal Neuroimaging and Developmental Science Center, Children's Hospital Boston at Harvard Medical School, [4]Athinoula A. Martinos Center for Biomedical Imaging, MGH at Harvard Medical School — By age 5, when normally-developing children have fairly stable semantic and syntactic skills, they begin to develop phonological awareness, that is, the knowledge that words consist of discrete bits of sounds. This oral-language skill is critical for successful acquisition of reading, writing and spelling. Recently, we reported associations in normally-developing children between amygdala volume at 6-months and global language abilities in the preschool years. Infants with larger right amygdalae at 6-months had significantly lower receptive and expressive language scores at 2, 3, and 4 years of age. In the present study, we investigated whether amygdala volume in infancy was also related to more specific oral-language abilities, such as phonological awareness. At 6-months, non-sedated structural MRIs were collected. At age 5, phonological awareness was assessed with the Phonological Awareness Test (PAT) and the Comprehensive Test of Phonological Processing (CTOPP). We found that children with larger total amygdala volume at 6-months had lower ($p > 0.05$) Rhyming (PAT), and lower ($p > 0.05$) Elision and Blending Words scores (CTOPP) at age 5. These results support our previous findings that amygdala volume in early infancy seems to influence later language and extends the predictive associations observed to the specific phonological abilities important to reading, writing and spelling competence. The mechanisms involved are as yet unclear and are in need of further investigation. We speculate that the functional amygdala lateralization found during early language acquisition might evolve to reflect a wider amygdalar contribution as more discrete metalinguistic abilities, such as phonological awareness, emerge.

I16

EFFECT OF STIMULUS QUALITY ON LANGUAGE PROCESSING IN YOUNGER AND OLDER ADULTS Daniel Roberts[1], Cady K. Block[2], Jane Barrow[1], Brian Taylor[1], George Buzzell[1], Carryl Baldwin[1]; [1]George Mason University, [2]University of Alabama — Previous research examining event-related potentials (ERPs) of language processing have observed that while the N100, thought to reflect sensory processing, is delayed in older relative to young adults, the N400 component, reflecting semantic processing, is not. One explanation for the delayed N100 response in older adults is reduced sensory acuity, while the comparable timescale of the younger and older adult N400 component may be due to greater experience among older adults in utilizing context. This was investigated using a sentence verification task presented at low and high stimulus intensity levels. Older and younger adults indicated whether the last word of a sentence was semantically congruent or incongruent with prior sentence context. Older adults were expected to exhibit delayed N100s, relative to younger adults, and this delay was expected to be particularly evident when sentence stimuli were presented at low signal intensity. Younger adults were expected to exhibit delayed N100 responses to low relative to high signal intensities. Further, due to their greater reliance on context to disambiguate degraded stimuli, older adults' N400s were expected to be less susceptible to lower signal intensities. Results partially confirmed these predictions. Older adults exhibited the typical pattern of delayed N100 relative to younger adults. Reduced signal amplitude resulted in delayed N100s and N400s in both age groups. However, the older adults' N100 and N400 responses were not differentially delayed relative to those of younger adults despite behavioral evidence for reduced accuracy and increased response times among older adults for the lower signal intensity conditions.

I17

NEUROPHYSIOLOGICAL INDICES OF SPEECH PERCEPTION IN INFANCY: LANGUAGE EXPOSURE AND MATURATION Yan Yu[1], Arsenia Barias[1], Hia Datta[1,2], Valerie Shafer[1]; [1]The University Center and Graduate School, City University of New York, [2]The Sackler Institute for Developmental Psychobiology, Cornell University — Many studies have shown that language exposure influences the development of speech discrimination, but few have examined the development of speech perception in children raised in a bilingual environment. This study investigates the maturational changes of event-related potential (ERP) Mismatch Responses (MMRs) in monolingual and bilingual infants. Over 80 infants (from three months to 15 months of age) listened to 250 ms, phonetically similar English vowel contrasts (I vs. E) presented in an oddball paradigm while ERPs were recorded from 65 scalp sites. Monolingual infants came from English-speaking household, and bilingual infants came from Spanish-English households. The results revealed both a positivity (p-MMR_followed by a negativity (n-MMR) at fronto-central scalp sites for the majority of children. Both the p-MMR and n-MMR shift earlier in latency with increasing age. The topography and latency of the MMRs were most strongly influenced by age, but both gender, for children under one year of age, and language experience affected the responses. Earlier onset of the n-MMR was observed for female infants and for toddlers with more English exposure. We speculate that the n-MMR indexes increased attention to the vowel differences and is the precursor to the adult mismatch negativity (MMN).

I18

LEFT PREMOTOR AND INFERIOR PARIETAL CORTEX ACTIVITY IN RESPONSE TO NON-NATIVE SPEECH SOUNDS DECREASES FROM CHILDHOOD TO EARLY ADOLESCENCE Yoon Han[1,4,5], Stephen Wilson[2], Kristin McNealy[3,4], Marco Iacoboni[1,4], Mirella Dapretto[1,4]; [1]David Geffen School of Medicine at University of California, Los Angeles, [2]University of California, San Francisco, [3]University of California, Los Angeles, [4]Ahmanson-Lovelace Brain Mapping Center, University of California Los Angeles, [5]Howard Hughes Medical Institute Research Training Fellowships for Medical Students, Chevy Chase, MD — It has been proposed that the developing brain becomes increasingly efficient at processing the patterns embedded in the ambient language through a process of neural commitment whereby expertise in processing one language may actually hinder the acquisition of other languages as the brain 'commits' to the sounds of one's native language. While this process begins in early infancy, the neural mechanisms underlying phoneme perception throughout development have not been well characterized. In this study, 25 thirteen-year-olds and 10 six-year-olds underwent functional magnetic resonance imaging (fMRI) as they repeatedly listened to 25 non-native and 5 native consonants each embedded between two [a] vowels. As expected, all participants showed strong bilateral activity in temporal regions while listening to both types of stimuli as compared to rest. Albeit weaker, significant activity was also observed in premotor areas. When directly comparing activity associated with listening to non-native versus native phonemes, both children and young adolescents showed significant activity in bilateral superior temporal cortex. However, only the younger children showed robust, statistically significant activity in left premotor cortex as well as in inferior parietal lobule. Direct between-group comparisons confirmed that activity in these regions was significantly stronger in children than adolescents. Our results support the notion that the auditory-motor networks in the left hemisphere may aid the formation of new phonetic codes for novel phonemes during childhood. Diminished involvement of this network by early adolescence may be related to the increased challenge of learning a new language with native like proficiency with age.

I19

SPEECH DEVELOPMENT OF MONOLINGUAL AND BILINGUAL TODDLERS: LANGUAGE MEASURES AND EVENT-RELATED POTENTIAL RESPONSES Carol Tessel[1], Nancy Vidal[1], Yan Yu[1], Hia Datta[1], Arsenia Barias[1], Valerie Shafer[1]; [1]The Graduate Center, City University of New York — Several studies suggest that speech perception in bilingual versus monolingual infants develops differently (e.g.,Bosch & Sebastian-Galles, 1997). The current study employed Event-related Potential (ERP) Mismatch responses (MMRs to investigate developmental changes in speech processing from 16 months to 3 years of age in monolingual and bilingual toddlers and to explore whether bilingual exposure to Spanish and English affects processing of vowel sounds that are phonemic only in English. . Over 60 toddlers (between 16 months and three years of age) listened to 250ms-long, phonetically similar English vowel contrasts (I vs. E) presented in an oddball paradigm while ERPs were collected from 65 scalp sites. English-learning children were recruited from monolingual English-speaking household, and bilingual children were from Spanish-English household. Detailed language background questionnaire and a battery of language-related tests were administered. ERP results show that a positive MMR followed by a negative MMR were obtained from the majority of monolingual and bilingual children across all the age groups. The latency of these MMRs shifted earlier with increasing age. A number of children from the bilingual group demonstrated later p-MMR responses than the age-matched monolingual controls. The shortening of peak latency of the p-MMR is likely to be due to the increase in amplitude and shortening of latency of the following n-MMR. We hypothesize that this n-MMR is the precursor of the adult MMN and can serve as an index of the development of phonological categories.

I20

AGE-RELATED DIFFERENCES IN CONTEXT USE IN INTACT AND DISTORTED SPEECH: AN ELECTROPHYSIOLOGICAL INVESTIGATION Kate Dupuis[1], Natalie Phillips[2], Katie Boodhoo[2], Kathleen Pichora-Fuller[1]; [1]University of Toronto, [2]Concordia University — Investigations using measures of event-related potentials have consistently identified a negative-going waveform approximately 400 milliseconds after stimulus onset (N400) which is more strongly elicited by unpredictable (The men talked about the mouse) than predictable sentence-final words (The cat chased the mouse). Thus, the N400 is sensitive to word integration into a context. While previous studies have shown that increased age and degradation of auditory stimuli attenuate the N400, these factors have not been studied simultaneously using sentence stimuli. In the current study, we investigated the effects of both age (younger: ages 18-30 years, older: ages 65-75 years) and stimulus degradation (intact, degraded) on participants' ability to successfully identify sentence-final words. Multi-band noise-vocoding was used to degrade the speech. Notably, the amount of distortion was varied to equate intelligibility across the two age groups (younger: 6-band vocoding, older: 8-band vocoding). All participants were more accurate in identifying the final words of high- compared to low-predictability sentences, and accuracy was reduced by degradation. Importantly, the difference between high and low context sentence accuracy was larger in the degraded condition. The N400 was observed for both age groups, but its amplitude was significantly attenuated by increased age, high context, and signal degradation. Importantly, in the degraded listening condition the difference in N400 amplitude between the two contexts was smaller for younger than for older adults, suggesting that the older group continued to use contextual information to improve processing, even under challenging listening conditions.

I21

CORTICAL SYSTEMS UTILIZED FOR READING AND TEMPORAL PROCESSING IN DEVELOPMENTAL DYSLEXIA Marita Partanen[1], Dorothy Edgell[2], Bruce Bjornson[1], Deborah Giaschi[1]; [1]University of British Columbia, [2]University of Victoria — Developmental dyslexia is defined as difficulty learning to read. Children with dyslexia often have deficits in phonological processing (encoding and decoding sounds of words), but they may also have deficits in temporal processing (perception and integration of rapidly presented stimuli). Behavioural research has indicated a link between reading and temporal processing ability, however, the cortical basis for this link has not been established empirically. The purpose of this project was to determine whether some of the same cortical regions are involved in reading and in temporal processing, and also if these regions are impaired in dyslexia. Functional magnetic resonance imaging (fMRI) was used to measure cortical activity in children with average reading ability and children with dyslexia between 13 and 16 years of age. Participants completed 2 reading tasks (phonological and orthographic) as well as 2 temporal processing tasks (auditory and visual). Results demonstrated that children with average reading ability did not have overlapping regions between reading and temporal processing. Children with dyslexia, however, showed overlapping regions between visual temporal processing and phonological reading. These results illustrate that a relationship between temporal processing and reading may only be important for those with reading problems. The current findings may assist in understanding the etiology of dyslexia.

Language: Syntax

I22

FUNCTIONAL MAGNETIC RESONANCE IMAGING OF SYNTACTIC AND PROSODIC COMPLEXITY EFFECTS Asaf Bachrach[1], Elodie Cauvet[1], Christophe Pallier[1]; [1]INSERM-CEA Cognitive Neuroimaging Unit, Neurospin, France — Many fMRI studies of sentence processing have manipulated syntactic complexity, attempting to identify neural networks involved in syntactic computations. However, most of them have made use of materials that confounded structural complexity per-se with other factors such as working memory (Stromswold et al 1996), verbal valance (Shetreet et al 2009) or prosodic structure. The present study manipulated syntactic and prosodic complexity in a crossed design, minimizing other differences. The stimuli were 4-member coordinated phrases (e.g. "The goat or the dog and the pig or the chicken"). Three types of syntactic structures were compared: fully right branching, complex middle branch, and complex left branch trees. Prosodic complexity was manipulated by varying the number of prosodic embeddings (3 vs. 2). Subjects performed a truth-verification task against a display presented at phrases' onsets. We found syntactic complexity effects in the Precuneus : both left branching structures activated it more than the right branching structure. 3 levels of prosodic embeddings produced increased activation relative to 2 levels of embeddings in the bilateral anterior Insula as well as the right inferior frontal gyrus. That the Precuneus plays a role in sentence processing has been pointed out by a number of recent studies (Ferstl et al 2008). Our results provide finer characterization of its function, demonstrating that its role is not tied (only) to lexical representation of certain verbs (Shetreet and colleagues) but is implicated in the representation of the abstract syntactic structure itself. Our results suggest a role for the Insula in prosodic structure processing.

I23

THE STRUCTURE SENSITIVITY OF MEMORY ACCESS: ERP EVIDENCE Brian Dillon[1], Wing Yee Chow[1], Taomei Guo[2], Fengqin Liu[2], Peiyao Chen[2], Colin Phillips[1,3]; [1]University of Maryland, [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, P. R. China, [3]Neuroscience and Cognitive Science Program, University of Maryland — There exists a debate as to the role of parallel and serial access memory mechanisms in the construction of online syntactic dependencies. One of the main sources of evidence that bears on this is the impact that structural distance has on the construction of these dependencies. We report evidence from evidence from event-related potentials (ERPs) that the construction of antecedent-anaphor dependencies is sensitive to the structural distance between the anaphor and its referent. We investigated the Mandarin Chinese long-distance reflexive ziji, which requires an animate, syntactically prominent antecedent. We manipulated the position and availability of ziji's antecedent in three conditions: local antecedent (LA), long-distance antecedent (LDA), and no antecedent (NA). ERP responses to these three conditions reveal two effects. First, the NA condition elicits a central N400 relative to the LA and LDA conditions. Second, the LDA condition elicits a later sustained anterior negativity relative to the LA and NA conditions. This sustained negativity is qualitatively similar to ERP effects that obtain when processing referential ambiguity, as reported in Van Berkum et al. (2007). This pattern of results is consistent with a model in which the resolution of the antecedent-anaphor dependency proceeds in two stages, where access to featural information precedes access to positional information. In conjunction with existing behavioral evidence, we interpret these results as support for theories of linguistic memory access that allow memory to be accessed through privileged points of access that correspond to structural positions in the parse.

I24

ROLE OF GRAMMATICAL VERSUS SEMANTIC INFORMATION IN LANGUAGE PROCESSING: EVIDENCE FROM AN ERP STUDY IN CHINESE Youyi Liu[1], Guangzhen Jia[1], Qirui Zhang[1], Hua Shu[1], Ping Li[2]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, P. R. China, [2]Pennsylvania State University — There has been a long-standing debate on the relative role and the time course of grammatical versus semantic information during language processing. Recent electrophysiological studies of Indo-European languages suggest that word category information plays a dominant role and could even block semantic processing, leading to the syntax-over-semantics view. The present study investigated this hypothesis in Chinese, a Sino-Tibetan language that shows distinct grammatical and semantic features from the languages studied so far. In Experiment 1, participants read sentences word by word. Compared to congruous sentences, combined word category and semantic violation sentences elicited both N400 and P600 effects. In contrast to previous studies, the current study indicated no E/LAN on word category violation. In Experiment 2, participants read classifier phrases - a firmer structure. Compared to congruous phrases, semantic only violation phrases showed an N400 effect, whereas combined word category and semantics violation elicited both N400 and P600 effects. In Experiment 3, participants read Chinese idioms. No difference was observed between semantic only violation and combined word category and semantic violation. Both conditions led to a similar biphasic N400 - P600 effect. In short, word category violation elicited no E/LAN in either of the three contexts. In addition, the N400 effect was also not affected by word category information. We conclude that the relative dominance of syntax versus semantics may be different for different languages. There is no evidence for the prevailing role of word category information over semantics during sentence processing in Chinese.

I25

NEUROPHYSIOLOGICAL EVIDENCE FOR EARLY PROCESSING DIFFERENCES BETWEEN PERFECTIVE AND IMPERFECTIVE VERB ASPECT Martin Paczynski[1], Gina Kuperberg[1,2]; [1]Tufts University, [2]Massachusetts General Hospital — Verb aspect, perfective versus imperfective, has previously been shown to affect discourse processing. For example, locations and tools associated with an action are more readily accessible following verbs in the imperfective aspect compared to the perfective aspect. However, less is known about how verb processing itself is modulated by verb aspect. In the current experiment we examined differences in event-related potentials (ERPs) evoked in response to verbs in the perfective aspect (e.g. The ranchers had branded…) versus those in the imperfective (e.g. The ranchers were branding…) aspect. Verb aspect was found to significantly modulate ERPs within the P200 time window, with verbs in the imperfective aspect evoking a greater negativity compared to those in the perfective aspect. Importantly, the effect was observed over right, centro-parietal sites, in contrast to previous linguistic studies which have reported modulation of the P200 at frontal electrode sites in response to word predictability. The effect reported here had a similar time course and scalp distribution to that previously reported on verbs in the passive, relative to active, grammatical voice. However, unlike grammatical voice, verb aspect was not found to modulate ERPs in the later P600 time-window, nor did verb aspect modulate ERPs within the N400 time-window. These data lend further support to syntactic information being processed within the first 200msec of word onset. Additionally, these data support the role of an early right parietal negativity (ERPN) component in language processing, distinct from other early linguisticly modulated components, such as the ELAN, N1, and frontal P200.

I26

EARLY NON-MOTOR SYMPTOMS IN DE NOVO PARKINSON DISEASE: PREDICTORS OF NON-LINGUISTIC AND LINGUISTIC SPEECH PROCESSING DEFICITS? Sonja A. Kotz[1], Kathrin Rothermich[1], Michael Schwartze[1], Maren Schmidt-Kassow[1], Katharina Mankel[2], Karla Eggert[2]; [1]MPI for Human Cognitive and Brain Sciences, Neurocognition of Rhythm in Communication Group, Leipzig, Germany, [2]Kompetenznetz Parkinson, Neurologische Universitätsklinik Marburg, Germany — While motor deficits are still considered as the primary dysfunction in Parkinson's disease (PD), recent evidence confirms that cognitive dysfunctions also develop during the disease progression. This is not surprising if one considers the multifunctionality of fronto-striatal circuitries. We investigated auditory selective target detection, linguistic rhythm perception, and syntactic processing in de novo PDs at disease onset (un-medicated) and one year post-onset (medicated) with event-related brain potentials (ERPs). While the P300 response to deviant auditory targets was comparable at disease onset and one year later, detection of rhythmic shifts in speech did not elicit the expected P600 at either time of measurement. The P600 elicited by morphosyntactic violations responded sensitive to rhythmic compensation, but varied in amplitude as a function of disease progression. The current results confirm that cognitive functions such as rhythmic and syntactic processing are affected at the very onset of PD, while selective target detection appears unaffected. The data are discussed in light of our recent proposal (Kotz et al., 2009) that a pre-SMA-striato-thalamic circuit in its capacity to tag temporal attributes (Pastor et al 2006) is responsible for the synchronization of predictive temporal and sequential cues (i.e. syntax) in speech.

I27

ERP RESPONSES TO MORPHOSYNTACTIC AGREEMENT VIOLATIONS IN A PASSIVE LISTENING TASK SHOW CONTINUITY BETWEEN CHILD AND ADULT LANGUAGE PROCESSING Sarah Kresh[1], Emily Zane[1], Valerie L. Shafer[1], Richard G. Schwartz[1]; [1]City University of New York Graduate Center — In this study, we used ERP to examine processing of morphosyntactic agreement violations in native English-speaking adults and children (mean age 8yrs). Participants underwent a passive listening task in which they were shown pictures of animals and heard habitual present tense sentences such as "The dog plays," "The dogs play," in the grammatical condition, and *"The dogs plays," *"The dog play," in the ungrammatical condition. The number of animals in the picture in the ungrammatical and grammatical match conditions corresponded to the grammatical number feature of the subject-NP in the auditory stimulus sentence. ERPs from verb offset were compared. Results show a persistent bilateral anterior negativity for adults and for children. Bilaterally, the children's negativity is slightly posterior to the adults'. On the left, the negativity for adults begins approximately 100 ms post stimulus offset and 250 ms after stimulus offset for the children. In the right hemisphere, the onset of negativity is simultaneous to the offset of the ungrammatical verb for both groups. These results evidence a striking similarity between the responses of our two groups, in line with results of previous ERP studies that have shown that the responses of children to morphosyntactic violations are similar to those of adults but that they are delayed. These results are important because this simple vocabulary and sentence structure along with the passive task are appropriate for use with younger children and language-delayed populations.

I28

L1 GRAMMAR INFLUENCES L2 PROCESSING: ERP EVIDENCE OF TRANSFER EFFECTS Karsten Steinhauer[1], John E. Drury[1], Nicolas Bourguignon[1], Kristina Kasparian[1]; [1]Centre for Research on Language, Mind and Brain; McGill University — In a recent review, Kotz (2009) notes that ERP data demonstrating first language (L1) influence on second language (L2) processing is fairly scarce. We conducted a sentence reading/ judgment study in English examining adjective-noun word order violations (e.g., 'He saw the white vase on the table' vs. 'He saw the vase *white on the table') with native English speaker participants and two L2-English groups who had either French or Mandarin as their L1. Crucially, the adjectives were sub-divided into those that occur post-nominally in French (e.g., white = blanc, cf. le vase blanc, not le *blanc vase) and those which, like English, occur pre-nominally (e.g., big = grand, cf. le grand vase, not le vase *grand). Both of these types pattern pre-nominally in Mandarin. If French-L1 grammar influences on-line processing of L2-English, then the patterns for the two adjective types should differ, whereas no differences between these types were expected for either the native or Mandarin-L1 groups. These predictions were confirmed. Both the native and Mandarin-L1 groups showed an N400/P600 response to post-nominal English adjectives, with no differences between the adjective sub-types. In contrast, this same pattern emerged for the French-L1 group only for the adjectives that occur pre-nominally in French (e.g., big). For the post-nominal adjectives, French-L1 speakers showed first a P600-like effect associated with the L2-grammatical (but L1-ungrammatical) pre-nominal adjective, which was followed by the N400/P600 pattern for the L2-ungrammatical post-nominal adjective. L1-grammar briefly impinges on L2 sentence processing, but these effects are rapidly overridden.

I29

WHY "THE USE OF ELECTRONIC DEVICES ARE NOW PERMITTED ON THE AIRCRAFT": ELECTROPHYSIOLOGICAL MEASURES OF COMPLEXITY IN LONG-DISTANCE AGREEMENT Darren Tanner[1], Lee Osterhout[1], Janet Nicol[2]; [1]University of Washington, [2]University of Arizona — Language processing in English requires the integration of grammatical features between the subject noun phrase (NP) and verb inflections. Behavioral research indicates that subject-verb agreement processing becomes more difficult as the complexity of the subject NP increases (Bock & Miller, 1991; Pearlmutter et al, 1999). We investigated the neurocognitive correlates of complexity in agreement processing by recording event-related potentials as subjects read English sentences. Experiments 1 and 2 studied the effects of number interference on subject-verb agreement processing in sentences with complex subject NPs, where the number feature of the two nouns in the subject either matched or mismatched and where the verb either agreed or disagreed with the head noun (e.g., The boy with the big trophy/trophies has/*have…). Results showed that disagreeing verbs elicited a P600 response, but that P600 amplitude was significantly smaller when the second noun was plural. Consistent with behavioral findings, this suggests that the second noun's plural feature interfered with the computation of subject-verb agreement. Experiment 3 investigated the role of syntactic complexity on this number interference effect. We contrasted length-matched prepositional phrase (PP) and relative clause (RC) subject modifiers (The boy [with the big trophies/who won the trophies] has/*have…). Agreement mismatches at the verb again elicited a P600 effect, but no differences were found between the PP and RC conditions. This finding suggests that RC modifiers may not exert an 'insulating' influence on a noun's plural feature during comprehension, as has been argued for speech production (Bock & Cutting, 1992).

I30

A LATE P600: EVIDENCE OF NP INTERPRETATION BEYOND FEATURE CHECKING Veena D. Dwivedi[1], Natalie A. Phillips[2], Shari R. Baum[3]; [1]Brock University, [2]Concordia University, [3]McGill University — We used event-related brain potentials (ERPs) to investigate the nature of morpho-syntactic verb-argument violations that occurred in sentences containing anaphoric subjects. The majority of work that investigates morphosyntactic subject-verb violations (e.g., Osterhout & Holcomb 1992, Hagoort et al. 1993) examines sentences that occur in isolation. In the present experiment, subject NPs were anaphoric to quantified NP subjects of the previous context. S1: Few brothers were eating pie. S2: The brothers were/ *was eating cake instead. Forty trials containing context sentences with quantified subjects were developed. Half the time, the quantifier was an existential "a" and the other half of the time, the quantifier was many, most, few, all or no. Continuation sentences contained subject anaphors which were either definite NP anaphors as above, or pronouns. We examined ERPs at the auxililary Verb position and found a later than usual P600 effect (which peaked at 800ms). We interpret the timing of this effect to indicate that checking for subject-verb agreement requires that the mind/brain interpret the meaning of the subject NP (via co-reference) prior to, or in addition to, simply checking whether there is a simple morpho-syntactic match between number features of the subject and verb. In addition, we found a left-lateralized N400 effect (trend only at midlines). We interpret these findings in the context of hypotheses concerning the syntactic/semantic status of the feature Number and reference; ie, the mismatch at the verb "was" is interpreted as a thematic verb violation (cf. Kuperberg, 2007), in addition to a morphosyntactic anomaly.

I31

WHEN COMPLEX GRAMMAR MUST PASS THE BOTTLENECK OF DEGRADED ACOUSTICS: AN FMRI STUDY Lars Meyer[1], Jonas Obleser[1], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — How does the analysis of language structure (syntax) depend on acoustic signal analysis in auditory language comprehension? We scrutinised this interaction and tested the functional neuroanatomy of increasing syntactic complexity (argument scrambling to three varying degrees) using auditory fMRI (Exp. 1). Then, syntactic complexity was additionally combined with three levels of acoustic degradation (8-, 16- and 32-band noise-vocoding; Exp. 2). In Exp. 1 (N=16), left anterior and posterior STS/STG as well as the left IFG -- including the frontal operculum -- were linearly more activated by increasing syntactic complexity. In Exp. 2 (N=14), while broadly confirming the activation pattern, additional introduction of acoustic degradation modulated the syntax-related peaks: While increasing signal quality did not shift the IFG activation, decreasing signal quality added up with syntactic complexity and shifted the IFG peak to a more posterior-medial-superior location (most likely to the inferior frontal sulcus). Along STS, the syntactic complexity effects in Exp. 2 did also exhibit an anterior peak (just anterior and inferior to Heschl's Gyrus) and a posterior peak in STS. However, both peaks were shifted towards the mid section of the STS and into STG, when the additivity with decreasing signal quality was taken into account. The results speak to an "upstream delegation" hypothesis for auditory sentence processing: More signal-bound, presumably less abstract processing areas (mid sections of the STS/STG; IFG posterior and superior to BA 44/45) become relatively more recruited as the quality of the signal (from which syntactic structure has to be decoded) drops.

I32

SYNTACTIC PROCESSING IN PROFICIENCY MATCHED ADULT MONOLINGUALS AND LATE BILINGUALS: AN ERP-FMRI STUDY Eric Pakulak[1], Mark Dow[1], Helen J. Neville[1]; [1]University of Oregon — Several event-related potential (ERP) and neuroimaging studies have reported that neural organization for syntactic processing is altered by delays in age of acquisition (AOA) as short as 4-6 years (e.g.,Wartenburger et al., 2003; Weber-Fox & Neville, 1996). However, as such delays in acquisition are typically associated with lower language proficiency (e.g., Johnson & Newport, 1989), it is difficult to assess whether differences in AOA or proficiency lead to these effects. Here we explore this relationship by varying AOA while controlling for proficiency and by employing complementary neuroimaging methodologies, ERPs and functional magnetic resonance imaging (fMRI). The neural response elicited by phrase structure violations was compared in monolingual native English speakers and native German speakers who began acquiring English between 11-13 years of age and whose scores on standardized tests of English proficiency matched those of the monolingual speakers. Syntactic violations in the ERP paradigm elicited both an early anterior negativity and a posterior positivity (P600) in the monolingual group, but only a P600 in the bilingual group. In the fMRI paradigm, violations elicited activation in inferior frontal as well as temporoparietal regions in the monolingual group, but activation was limited to temporoparietal regions in the bilingual group. These results provide converging evidence from complimentary methodologies that late bilinguals rely on different neural regions to achieve a level of proficiency comparable to some native speakers.

I33

SHOW US THE BASELINE: ON THE STATUS OF SYNTACTIC ELAN EFFECTS IN READING STUDIES John E. Drury[1], Michael T. Ullman[2], Karsten Steinhauer[1]; [1]McGill University, [2]Georgetown University — In the seminal work of Neville et al. (1991), event-related potentials were used to examine the processing of phrase-structure violations (e.g., "He criticized...Max's proof OF the theorem", versus "...Max's *OF proof..."). ERPs time-locked to the preposition demonstrated three violation effects: (i) an early left anterior negativity (their "N125", interpreted as an "eLAN" effect in Friederici 1995 and subsequent), (ii) a left lateralized temporal/parietal negativity (300-500 ms), and (iii) a subsequent late posterior positivity. We present data from two separate studies which aimed to replicate these findings. Though (ii)/(iii) were robust in our data, we found evidence for (i) only in one of our two studies. Further, we also uncovered evidence raising serious concerns about this type of violation paradigm. ERPs time-locked to the onset of the words immediately preceding the violation-point demonstrated significant sustained relative negativities with left/anterior scalp distributions for the violation condition (i.e., for "Max's" relative to "proof"). This effect persisted beyond the onset of the target prepositions, making it impossible to distinguish it from any actual violation effects. Furthermore, inspection of the literature reveals that: (i) very early LAN effects are not reliable across reading studies, (ii) every such study which has reported them deployed contrasts with similar confounds. Moreover, eLANs have never been found in reading studies which avoid such baseline confounds. Apart from the obvious methodological lessons for future studies of syntactic processing, the combined picture undermines one of the most widely cited sources of evidence in favor of serial, "syntax-first" models of sentence processing.

I34

ERP EVIDENCE FOR A ‘LATE CORRECTION’ MEMORY RETRIEVAL STRATEGY IN OLDER ADULTS Kristine Wilckens[1], Haoxuan Xu[1], Eric Signoff[2], David Wolk[3], Mark Wheeler[1]; [1]University of Pittsburgh, [2]George Washington University, [3]University of Pennsylvania — Age-related impairments often include difficulty accessing memories that require controlled processing. Jacoby et al (2005) propose that young adults may adopt an ‘early selection’ retrieval strategy involving frontally-mediated constraint of the memory search space, which may allow for more efficient retrieval. Older adults may instead use a ‘late correction’ retrieval strategy. We provide behavioral and ERP evidence to support this model of age-related differences in memory retrieval. Using a cued memory task in which subjects switch or repeat the same retrieval task trial by trial (Morcom & Rugg, 2001), we found that repeating the same memory task increased memory performance in young but not older subjects. We then examined differences in ERPs between age groups within the preparatory and retrieval phases. Consistent with previous findings (Morcom & Rugg, 2001; Herron & Wilding, 2006) within the preparatory phase, young adults showed task-related differences in ERPs within midfrontal sites for repeat, but not switch trials, suggesting young adults may adopt a retrieval mode (Tulving, 1983). In contrast, the older group did not show these preparatory differences in ERPs prior to retrieval. Moreover, right frontal old/new effects were more sustained in older subjects compared with the young, suggesting that older adults are more likely to engage in post-retrieval monitoring. Taken together, these results are consistent with the hypothesis that young adults tend to rely on an ‘early selection’ retrieval strategy whereas older adults may tend to rely on a less efficient ‘late correction’ strategy which may have a detrimental effect on memory performance.

I35

COMPLEX SYNTAX IN LANGUAGE DEVELOPMENT: AN AUDITORY ERP STUDY IN ADULTS AND CHILDREN Jens Brauer[1], Anna Wilsch[1], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences — Processes of language parsing can be described by event-related brain potentials (ERPs) online. Languages with relative free word order like German permit to investigate the application of grammatical principles during sentence parsing. In this study, ditransitive sentence constructions were used to investigate the processing of syntactic complexity (low, medium, and high complex) induced by word order variations in German. Participants, children at age 10 and adults, were asked to indicate agent-patient relations as expressed in the sentences. Adults showed broadly distributed negativities in ERPs between 400 and 600 msec after noun phrase (NP) onsets with a parametric modulation of this effect on the critical NP (NP2) driven by complexity level. Moreover, the final NP (NP3) was characterized by a pronounced and sustained positivity in high complex sentences. Children’s data revealed comparable ERP components, but different effects. They did not show the same modulation of ERPs with increasing complexity as found for adults, rather the effects for the medium complex condition resembled that of the high complex condition. These data indicate that sentence parsing in children is characterized by the same relevant online processes as found in adults and expressed by a negative and a positivity ERP component on NPs. Nevertheless, in 10-year-olds the parsing system has reached its limits for both processes at a lower complexity level than found for adults. Behavioral data support this view by demonstrating that performance in children is decreased for both medium and high complex constructions.

I36

NEUROTRANSMITTER RECEPTOR DISTRIBUTION FOR FUNCTIONAL ACTIVATIONS FOUND IN BROCA’S REGION IN THE HUMAN CEREBRAL CORTEX Mareike Trams[1], Karl Zilles[2,3], Katrin Amunts[2,4], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Neuroscience and Medicine, Research Center Juelich, Germany, [3]C. & O. Vogt Institute for Brain Research, Heinrich Heine University Duesseldorf, Germany, [4]University Hospital Aachen, RWTH Aachen University, Germany — The density of neurotransmitter receptors varies between different regions in the human cerebral cortex. We hypothesized that this variation may be correlated to the functional organization of the cortex. In order to test this hypothesis, activation clusters from a functional imaging study concerning human language processing in German syntax were analyzed by quantitative autoradiography. An upper part of the Broca’s region, the cortex of the left inferior frontal sulcus, necessary for working memory during processing of sentences with a long distance between syntactically dependent elements (i.e. subject nouns and their respective verbs) was compared to a posterior part of Broca’s region, the cortex of the left pars opercularis, involved in the processing of structural complexity of language in response to hierarchical structured sentences (i.e. center-embedding of clauses). In the functional experiment the two activations of language structure and working memory work cooperatively, so a similar receptorarchitectonic anatomy was predicted. Thus, the activation clusters for working memory and hierarchical language structure were registered in three post mortem brains to determine the regional distribution of the densities of different receptor types representing all classical neurotransmitter systems as well as the adenosine system. The receptor distribution patterns of brain areas with a cooperative function in hierarchical syntax processing, resemble each other very closely, whereas they could be clearly segregated from other functionally identified cortical areas, such as the primary sensory or motor cortex. Thus, receptor distribution patterns represent an organizational structure strictly correlated with specific cognitive brain functions in the human cerebral cortex.

I37

THE AUDITORY SENSORY HYPOTHESIS OF THE EARLY LEFT ANTERIOR NEGATIVITY Evan D. Bradley[1], Arild Hestvik[1]; [1]University of Delaware — According to Friederici (2002), early left anterior negativity (ELAN) indexes unexpected syntactic categories. Dikker (2009) proposed a "sensory ELAN hypothesis" to account for its early occurrence, asserting sensory cortex accesses grammatical information, generating ELAN for targets whose form violates top-down predictions. Previous studies examined only visual processing, finding ELAN only for targets with closed-class morphology. Our study extended this research to auditory processing, comparing illicit filled-gap NPs introduced by closed-class morphology (1) to bare NPs (2) (ERP computed between test (a) and control (b), time-locked to NP onset): (1a)*the zebra that the hippo kissed [the camel] on the nose ran away. (1b) the weekend that the hippo kissed [the camel] on the nose he ran away. (2a) *the zebra that the hippo kissed [camels] on the nose ran away. (2b) the weekend that the hippo kissed [camels] on the nose he ran away. Hestvik (2007) demonstrated ELAN for (1a). The sensory hypothesis predicts no ELAN for (2a), which lacks morphology facilitating auditory diagnosis; Friederici's model predicts ELAN for both. We found morphologically-marked targets elicited anterior negativity 300ms post-target, matching left anterior negativity (LAN), indicating unexpected category; and centro-parietal positivity 600ms post-target, matching P600, indicating reanalysis. Morphologically-unmarked targets elicited central negativity 400ms post-target, matching N400, suggesting semantic incongruity. Although no ELAN occurred, N400 suggests later recognition of bare targets; without morphology, category is not extractable from form; the entire word is heard before categorization occurs and semantic integration proceeds. Results support the sensory hypothesis, but LAN/N400 interpretation questions will be discussed.

I38

THE ROLE OF SYNTACTIC PARAMETERS IN L2 PROCESSING: EVIDENCE FROM EVENT-RELATED POTENTIALS Adam Zawiszewski[1], Itziar Laka[1]; [1]University of the Basque Country, Vitoria-Gasteiz, Spain — Several ERP studies on native versus non-native language processing have argued that the observed differences result either from the speakers' Age of Acquisition (AoA) or from the level of language proficiency attained, but the impact of these factors is still unclear. Some recent results suggest that the relative impact of AoA and proficiency on non-native language processing correlates with language distance. We suggest that maturational effects obtain when a structural trait of the non-native (L2) language is absent in the native (L1) grammar; otherwise, non-native processing will approximate native processing as levels of proficiency increase. Here we report the results of the head-parameter, object-verb (OV) agreement, ergative case and semantic processing study in native and very proficient non-native speakers of Basque (AoA 3yrs), whose native language is Spanish. Our data indicate that very proficient non-natives differ from natives when processing aspects of grammar related to the head parameter (long frontal negativity) and ergativity (lack of P600), but do not show differences when dealing with OV agreement (same N400-P600 pattern) or semantics (similar N400). These findings suggest that the aspects of L2 syntactic processing that are influenced by even a relatively minor delay in AoA involve a syntactic parameter (the head parameter and ergativity in this case) that diverges in its specification from the speaker's L1, whereas aspects of the L2 that parametrically converge like verb agreement in our study, or aspects that are not subject to parametric specification like semantics, are not affected by age.

Long-Term Memory: Episodic

I39

NEUROMAGNETIC ACTIVITY DURING AN EMOTIONAL THINK/NO-THINK TASK Anne Hauswald[1], Johanna Kissler[1]; [1]University of Konstanz — For effective memory functioning, memory control processes are needed that suppress outdated or unwanted information. The present study investigated neuromagnetic dynamics underlying intentional memory suppression using the think/no-think (TNT)-paradigm. Participants first learned cue-target associations and were then asked to actively retrieve (T-trials) or actively suppress (NT-trials) the target in response to cue presentation. In the final retrieval task, participants were required to retrieve all items regardless of the initial TNT instruction. Faces with neutral expressions were used as cues and complex neutral and negatively arousing pictures as targets to explore whether memory control is affected by emotional content of the suppression target. Magnetoencephalographic (MEG) activity of 28 participants was recorded and minimum-norm source localization was conducted to investigate the neural correlates. Behavioral results suggest that while unwanted memories can indeed be suppressed, not everyone is capable of this memory control mechanism (suppressors - nonsuppressors). Further, no evidence was provided for altered memory control of negative information. MEG data showed that, during initial encoding, nonsuppressors exhibited enhanced activity compared to suppressors, presumably reflecting deeper encoding. During the TNT phase however, suppressors yielded stronger activity in early latencies than nonsuppressors. Especially during T-trials suppressors showed increased activity in centro-parietal areas in late time windows, presumably reflecting enhanced retrieval attempts which might have secondary effects of impairing retrieval of NT-items. The results indicate that, neutral and negatively arousing memories can be actively suppressed and that this memory control mechanism (1) is modulated by initial encoding and (2) is a byproduct of retrieval effort.

I40

THE NEURAL BASIS OF JUDGEMENTS OF RECENCY: EVIDENCE FROM FMRI Andrea Greve[1], Amie Doidge[1], Edward Wilding[1]; [1]Cardiff University — Remembering when an event occurred is a fundamental characteristic of episodic memory, but knowledge about the neural processes supporting 'when' judgments is incomplete, as is knowledge about the relationship between processes supporting 'when' judgments and other kinds of episodic memory decisions. Temporal judgments can be based upon distinct kinds of information. First, increases in a memory strength signal can be used heuristically to gauge how recently events occurred. Second, recovery of qualitative information can permit an event to be placed accurately in time. To contribute towards an understanding of the neural bases of temporal judgments, event-related fMRI data was acquired during a continuous verbal recognition memory task. The lag between presentation and re-presentation for test words was varied systematically and participants indicated the old/new status of test words, as well as estimating the number of intervening words (the 'lag') between first and second presentations. Successful retrieval was associated with activation in multiple brain regions, including lateral parietal cortex, precuneus, occipital fusiform and frontal regions. The lateral parietal cortex showed increased activation with shorter lag judgements, independent of the actual lag. This pattern of findings suggests that this region supports recency judgments in a strength-based manner. Occipital fusiform regions, by contrast, predicted the accuracy of lag judgments in an all or none manner: greater activation for correct than for incorrect lag judgments, independent of lag. These findings are consistent with the view that two functionally distinct memory processes contribute to 'when' judgments.

I41

MEMORY RETRIEVAL LIMITS THE CONTRIBUTION OF PREFRONTAL CORTEX TO SUCCESSFUL ENCODING Noa Ofen[1], Xiaoqian J. Chai[1], John D. E. Gabrieli[1]; [1]MIT, Cambridge, MA — Retrieval of information from memory requires strategic control over mnemonic processes. The interaction between cognitive control and mnemonic processes is not fully understood. In particular, it is not clear whether increased demand for control during memory retrieval can influence incidental encoding of novel information. In this study, eighteen participants studies 140 pictures of indoor and outdoor scenes, half of which were repeated 12 times (x12 pictures, strong memory), and half were repeated 3 times (x3 pictures, weak memory). Participants were then scanned while making recognition decisions (old/new) for the studied pictures and 140 novel pictures (foils), with x12 and x3 pictures presented in separate runs. Participants were faster and more accurate in recognizing x12 pictures compared to x3 pictures, suggesting that runs with x12 pictures constituted a strong memory context while runs with x3 pictures constituted a weaker memory context. Activations in lateral prefrontal cortex (PFC) were associated with retrieval success (Hit>CR) in the weak, but not strong, memory context, indicating increased demand for cognitive control in the weak memory context. Following the scanned recognition test, participants were given a second, surprise, recognition test with the previous foils and 140 novel pictures. Participants had similar rates of successfully encoding foils from runs with weak and strong memory contexts. Activations in the PFC, however, were associated with successfully encoding foils in the strong, but not in the weak, memory context. These results suggest that increased demand for PFC involvement during controlled memory retrieval reduces its involvement in incidental memory encoding.

I42

THE NEURAL CORRELATES OF SINGLE-ITEM AND MULTIPLE-CHOICE RECOGNITION Brandon Ally[1,2], Paul Costanza[1,2], Joshua McKeever[1,2], Andrew Budson[1,2]; [1]Boston University School of Medicine, [2]Center for Translational Cognitive Neuroscience, Bedford, VA — It is currently unknown whether the cognitive and neural processes that occur during forced-choice recognition differ from those that occur during yes/no recognition. Although research suggests that individuals tend to rely more on recollection for single-item recognition and more on familiarity for multiple-choice recognition, previous studies have not taken into account basic differences in experimental design that may explain behavioral performance differences. We set out to determine the relative contribution of recollection and familiarity during these two tasks. In addition to standard target and novel items, perceptually similar lures were presented at test for both single-item and multiple-choice tasks. Event related potentials (ERPs) were recorded at test. The standard old/new analysis with hits and novel correct rejections revealed a slightly more pronounced FN400 associated with familiarity for the single-item format, but that there was no difference in parietal activity associated with recollection between the two test formats. However, between approximately 150 and 600 ms, a prominent occipital effect was seen during the multiple-choice test. This occipital effect, along with a late frontal effect, was also present for the multiple-choice condition when novel correct rejections were subtracted from the correct rejection of the lures. No ERP effects were noted here for the single-item condition. We speculate that early occipital activity may reflect implicit processing or bottom-up pattern matching to support recognition when faced with difficult decisions, such as with highly similar foils. Further, frontal regions may work to modulate or inhibit responding based on enhanced processing of an item or familiarity.

I43

STIMULUS-SPECIFIC ITEM AND DOMAIN-GENERAL CONTEXT MEMORY ENCODING IN THE MTL Hilary Watson[1,2], Edward Wilding[1,2], Kim Graham[1]; [1]Wales Institute of Cognitive Neuroscience, School of Psychology, Cardiff University, Park Place, UK, [2]CUBRIC, School of Psychology, Cardiff University, Park Place, UK — One account of the role of the medial temporal lobe (MTL) in recognition memory is that perirhinal cortex (PrC) processes item information, parahippocampal cortex (PHC) context information, and the hippocampus binds item and context (Diana et al, 2007). It is currently unclear how different MTL regions contribute to memory for different stimulus types. The current experiment was designed to address this by investigating the neural correlates of item and context memory encoding for objects and scenes. During fMRI scanning, participants studied scenes and objects in one of two semantic encoding tasks. During test participants made item (old vs. new) and context (encoding task) memory judgements. Functional localisers were used to identify voxels sensitive to object and scenes within PrC, PHC, anterior hippocampus (antHC) and posterior hippocampus (postHC). Item and context effects were queried within these content sensitive voxels. Activity within the postHC and PHC predicted item memory (hits vs. misses) for scenes, but not objects The PrC exhibited an item memory effect for objects but not scenes. Activity within antHC predicted context memory for both scenes and objects, with greater activity for trials that were later identified in the correct study context versus those that were not. Notably, this region responded more to scenes compared to objects, which indicates that it also shows a preference for spatial processing. These data suggest that it is important to consider stimuli, as well as mnemonic information, when observing the division of labour within the MTL.

I44

MNEMONIC BENEFITS OF EXPERIENCE AS REVEALED BY FMRI: CONTRIBUTIONS OF SEMANTIC PROCESSING AREAS Jordan Poppenk[1,2], Anthony McIntosh[1,2], Morris Moscovitch[1,2]; [1]University of Toronto, [2]Rotman Research Institute — Contrary to recent theories of novelty enhancing memory, we have found that prior experience with stimuli enhances memory when confounds are controlled (Poppenk et al., submitted). However, the reason for this enhancement is unclear. One possibility is that experience, by establishing the relevant features of a stimulus, enables deeper and more efficacious encoding. Using fMRI, we scanned participants as they encoded novel, repeated, and pre-experimentally experienced verbal materials (proverbs), then administered a memory test. We replicated findings of superior memory for the two types of experienced proverbs. At the brain level, relative to memory for novel proverbs, memory for repeated proverbs was more closely associated with activity in semantic processing regions, such as the lateral frontal poles, and less associated with activity in stimulus-focused and language regions, such as the medial frontal pole and Broca's area. In contrast, pre-experimentally familiar (English) and novel proverbs shared similar memory-encoding mechanisms, but differed in the extent to which they were activated. Semantic processing areas in prefrontal cortex and anterior temporal lobes were more active throughout the time-course for English proverbs, whereas stimulus-focused and language regions were more active for novel proverbs late in the time-course. In showing that mnemonic experience effects are linked with a shift of processing from stimulus-focused to semantic processing areas, the current results suggest that depth of processing effects underlie mnemonic benefits of experience. This is consistent with proposals that pre-existing semantic knowledge is required for robust episodic encoding to occur.

I45

DISSOCIABLE EFFECTS OF REWARD AND PUNISHMENT MOTIVATION ON MEMORY PRECISION FOR SEMANTICALLY-RELATED WORD LISTS Katherine MacDuffie[1], Vishnu Murty[1], R. Alison Adcock[1]; [1]Duke University — Prior work has shown that reward motivation elicited prior to encoding enhances declarative memory for complex scenes (Adcock et al., 2006).

In the current study, we investigated the hypothesis that reward motivation has a qualitatively distinct effect on declarative memory formation compared to punishment motivation. We describe a dissociation between motivation by reward versus punishment on a subsequent memory test using semantically related (DRM) neutral word lists as memoranda. Each list of DRM words was preceded by a cue that indicated the reward (or punishment) associated with encoding (or failing to encode) the upcoming items. Cues indicated either a cumulative monetary bonus (reward cue) for successful remembering, a cumulative duration of highly aversive noises (punish cue) for forgetting, or no consequence for performance (control cue). In an immediate recognition test, there was no difference between cue types on overall recognition rate for studied items (F=1.58, p=.216). However, encoding motivated by avoiding punishment was associated with significantly more falsely-recognized semantic associates (F=3.45, p<.05) compared to encoding motivated by obtaining reward (p<.05). In contrast, encoding motivated by reward was associated with significantly greater source memory (F=17.12, p<.001) compared to encoding motivated by punishment (p<.05) and to the control condition(p<.05). Thus, motivation by punishment decreased discriminability by increasing false recognition memory, whereas motivation by reward enhanced source memory for studied items. These findings suggest that motivational states elicited by reward and punishment engender qualitatively different encoding states or strategies for declarative memory formation.

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FOR BOTH MEMORY AND PERCEPTION, DORSAL PARIETAL CORTEX MEDIATES TOP-DOWN ATTENTION AND VENTRAL PARIETAL CORTEX MEDIATES BOTTOM-UP ATTENTION Yonatan Mazuz[1], Jared Stokes[1], James Kragel[1], Ingrid Olson[2], Elisa Ciaramelli[4,5], Morris Moscovitch[4,6], Roberto Cabeza[1]; [1]Duke University, [2]Temple University, [3]University of Pennsylvania, [4]Rotman Research Institute of Baycrest Centre, [5]University of Bologna, [6]University of Toronto — According to the Attention to Memory (AtoM) model (Ciaramelli et al., 2008; Cabeza et al. 2008), dorsal parietal cortex (DPC) mediates top-down attention processes that guide memory search and monitoring operations according to retrieval goals, whereas ventral parietal cortex (VPC) mediates bottom-up attention processes that are captured by recovered memories. The AtoM model assumes that these attentional processes are similar for memory and perception, and it predicts that attention-related DPC and VPC activations for cognitive functions should overlap. Although the overlap prediction is generally consistent with meta-analyses of fMRI literature, the goal of the present fMRI study was to test it directly by comparing the distribution of parietal activations during memory and perception tasks within-participants. In each trial of the memory task, participants covertly recalled a previously-studied 4-word chain (e.g. dog >> cat >> tiger >> stripe) and pressed a key upon recalling the fourth word. In each trial of the perception task, participants viewed a rapidly-presented stream of consonants and pressed a key when detecting a vowel. In both tasks, top-down "search" was modeled as sustained activity from trial onset to the response, and bottom-up "detection" was modeled as transient activity immediately before the response. Conjunction analyses showed search-related activity in DPC (intra-parietal sulcus—IPS) and detection-related activity in VPC (temporo-parietal junction—TPJ) for both memory and perception tasks. These findings are consistent with the AtoM model: memory and perception engaged overlapping DPC regions for top-down attention and overlapping VPC regions for bottom-up attention.

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NEURAL CORRELATES OF WORD REPETITION, PROCESSING FLUENCY, AND RECOGNITION MEMORY Heather D. Lucas[1], Jason R. Taylor[2], Rik N. A. Henson[2], Ken A. Paller[1]; [1]Northwestern University, [2]MRC Cognition and Brain Sciences Unit, Cambridge UK — When a stimulus is encountered for a second time, both explicit recognition memory and implicit priming can occur. Priming and recognition are mnemonic expressions commonly attributed to neurobiologically distinct memory systems. However, debate surrounds the extent to which recognition can be influenced by the same increases in processing fluency that support priming for repeated stimuli. Under some circumstances, fluency may give rise to feelings that an item has been previously encountered, thus increasing the likelihood that participants will endorse items as "old" on recognition tests. Woollams, Taylor, Karayanidis, and Henson (2008) used masked primes immediately preceding test cues to identify distinct neural correlates of fluency and explicit memory during recognition testing. The present study extends these findings by examining neural signals of repetition priming with a 600-ms delay interposed between the prime and test cue. Like Woollams and colleagues (2008), we found an increase in the proportion of "old" judgments when the masked word was the same as the test cue relative to when it was different (i.e., the Jacoby-Whitehouse effect, 1989). We also replicated previous findings of reduced centroparietal N400 potentials associated with masked priming. Additional patterns of neural activity were associated specifically with priming of unstudied items, perhaps reflecting an aspect of conceptual processing. These findings highlight that fluency can stem from multiple sources—including orthographic, lexical, and conceptual levels of processing—that may differ in the timecourse with which they become available after a prime is presented.

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THE EFFECTS OF SEMANTIC RELATEDNESS ON CONTEXT-SPECIFIC OBJECT RECOGNITION Kevin Kawa[1], Devin Duke[2], Jonathan Parch[1], Jose Cardoza[1], Lynn Nadel[1], Lee Ryan[1]; [1]University of Arizona, [2]University of Western Ontario — Hayes, Nadel, and Ryan (2007) demonstrated that object recognition performance decreased by approximately 15% following a change in context from study to test, specifically, when objects studied in a complex scene were then tested on a white background. The decrement was observed regardless of whether encoding was intentional or incidental, suggesting automatic binding between the object and the scene. This automatic binding may have occurred because the objects were presented in scenes that were strongly semantically related to the object – a vase on a coffee table, a lamp on an office desk, etc. To investigate the influence of semantic relatedness on context-specific object recognition, the present study varied the specific context from study to test while maintaining semantic relatedness between the object and the context. Household objects (e.g., teapot) were presented in a strongly semantically related scene (e.g., a kitchen). The objects were then tested in either the identical context (the same kitchen), a semantically similar context (another kitchen), a different but equally semantically related context (a dining room), or on a white background. Results showed a stepwise decrease in recognition performance – the same kitchen > another kitchen > a dining room > a white background. Thus, recognition was supported by both the semantic similarity of the context from study to test, as well as the specific visual details of the scene. While optimal recognition occurs when the exact same context is presented, other semantically appropriate contexts may still be used to aid in retrieval of episodic information.

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WORKING MEMORY IS NOT THE PATHWAY TO THE CREATION OF LONG-TERM MEMORY Bethany C. Y. Wu[1], David E. J. Linden[1], Christoph Klein[1], Stephan G. Boehm[1]; [1]School of Psychology, Bangor University, Wales, U.K. — Working and long-term memory have long been considered distinct memory systems. For example, we have recently shown evidence from event-related potentials (ERPs) of differences between memory systems of the processes supporting memory encoding, the attempt to retrieve from memory and the success of retrieval. Furthermore, it is widely believed that working memory is the pathway to long-term memory. Here, we attempted to replicate our previous findings. In addition, we investigated the proposed pathway to the creation of long-term memory by comparing long-term memory performance for items studied in either a working or a non-working memory task. Famous faces were encoded in a working memory or a familiarity task and tested later in either an episodic memory or a priming test. ERPs showed topographically and temporally different old/new effects for working (400-500 ms, 500-600 ms) and episodic memory (275-375 ms, 500-650 ms). ERPs of retrieval attempt from working and episodic memory also differed. In the episodic memory test, performance measures were not affected by the study task. In the priming test, priming was present for faces from both study tasks; similarly to the episodic memory test, the amount of priming did not differ between study conditions. Our results replicate our prior findings of dissociations in ERPs between working and long-term memory. Moreover, the lack of performance advantages from working over non-working memory encoding challenges the common view of working memory as the pathway to the creation of long-term memory.

I50

EPISODIC RETRIEVAL OF PERCEIVED AND IMAGINED ITEMS STUDIED BY ELECTROENCEPHALOGRAPHY (EEG) Timm Rosburg[1], Axel Mecklinger[1], Mikael Johansson[2]; [1]Saarland University, Germany, [2]Lund University, Sweden — In the current study, we investigated episodic retrieval of perceived and imagined items by event-related potentials (ERPs) and event-related spectral perturbations (ERSPs). 27 subjects took part in a recognition experiment, consisting of an incidental study phase and a subsequent test phase. During the study phase, 92 nouns characterizing concrete objects were presented either followed by drawings of these objects or followed by the instruction to mentally visualize them. During the test phase, items of one category were defined as targets and had to be classified as "old", while items of the other category together with newly presented items had to be rejected. ERPs and ERSPs were calculated for each category of items and compared between conditions. Analysis of behavioral data revealed that perceived and imagined target items were equally well recognized, but subjects responded significant slower to imagined target items. The ERPs to imagined targets showed a larger late posterior negativity (LPN) than the ERPs to perceived targets, with differences starting at about 850 ms. This modulation of the LPN was accompanied by systematic changes in the ERSP of delta band activity, but not by changes in phase-locking. Even though the equal memory performance indicates that retrieval of imagined items was as successful as retrieval of perceived items, both the longer reaction times and the increased LPN suggest that the reconstruction of previously imagined memory items requires more processing time and higher mental efforts.

I51

EFFECTS OF PERCEPTUAL EXPERTISE ON RECOGNITION MEMORY Grit Herzmann[1], Tim Curran[1]; [1]University of Colorado at Boulder — Although perceptual expertise is known to improve early visual processing, there has not been a direct investigation of its effect on memory. We used behavioral measures and event-related potentials (ERPs) to determine how perceptual expertise facilitates recognition memory. The electroencephalogram of sixty-one subjects was recorded as they completed a remember/know paradigm with car and bird stimuli. Experts and novices for cars were defined as the 20 participants with the highest and lowest performances for cars, respectively, in a subordinate matching task. ERPs for all subjects were correlated with performance in recognition and subordinate matching. No group differences or correlations were found for behavioral data or ERPs with birds, but expertise affected car recognition in several ways. Experts recognized cars more accurately and "remembered" old cars more often than novices. Novices made more false alarms. Memory performance correlated directly with subordinate matching. The FN400, related to familiarity processes, was more pronounced over right frontal areas for experts. More positive differences in amplitudes between "known" old and new cars at these areas were associated with fewer false alarms. The parietal old/new effect, related to recollection processes, was found for experts but absent for novices. A more positive parietal old/new effect was associated with more accurate memory performance, more accurate "remembered" judgments, and better subordinate matching. Perceptual expertise thus facilitates both familiarity and recollection processes of recognition memory. Like perceptual processing, perceptual expertise can be assumed to sharpen the discrimination between exemplars in long-term memory by supporting more detailed and distinct representations.

I52

TEMPORAL DYNAMICS OF BLOOD-OXYGEN-LEVEL DEPENDENT (BOLD) RESPONSES IN THE MEDIAL TEMPORAL LOBE DURING ASSOCIATIVE ENCODING Katherine Duncan[1], Bernhard P. Staresina[1], Lila Davachi[1]; [1]New York University — Functional magnetic resonance imaging has proven to be an invaluable tool for investigating the mnemonic roles of individual medial temporal lobe (MTL) regions. The success of this tool, however, has been curtailed by the poor signal-to-noise ratio of BOLD responses in the MTL. In the current study, we used a slow-event related design to assess how variability in the shape of BOLD responses (across individuals and across time) may contribute to this problem. During the scanning session subjects performed an associative encoding task and then later, outside the scanner, had their memory tested for the presented items and associated source information. Preliminary imaging analyses show that, while responses are relatively stable across runs in earlier visual areas, responses in the hippocampus declined dramatically over the hour-long scanning session. Additionally, large between-subject differences were found in the shape of hippocampal responses, with many subjects' responses being well fit by a canonical hemodynamic-response function while others had responses with negative amplitudes and extended widths. Interestingly, we found some evidence that this between-subject difference in response shape may be reflected in their subsequent memory performance. We are also exploring improvements in the sensitivity of analysis approaches that take these sources of variability into account.

I53

NEURAL CORRELATES OF CUED-RECALL WITH AND WITHOUT RETRIEVAL OF SOURCE INFORMATION: AN FMRI STUDY Hiroki R. Hayama[1], Michael D. Rugg[1]; [1]Center for the Neurobiology of Learning and Memory, University of California, Irvine — Numerous fMRI studies have investigated the neural correlates of successful item or source memory. Few studies however have investigated the neural correlates of successful cued recall, and none have combined tests of cued recall and source memory. Accordingly, the present study addressed the question whether the neural correlates of cued recall vary according to whether or not source retrieval is successful. The study comprised two identical study-test cycles. In each study phase 60 words were presented, each word appearing either to the left or right of fixation. Test items comprised three-letter word stems, two-thirds of which corresponded to study items. The requirement was to use each stem to try to recall a word from study. If recall was successful, the word and the side on which it had been presented at study were stated. When recall failed, the first word to come to mind was stated. Thus, two classes of 'recollected' item were identified – those correctly recalled and associated with a correct source judgment, and those recalled and associated with an incorrect judgment. Recall effects (Correct + Incorrect Source > Correct Rejection (CR)) were evident bilaterally in retrosplenial/cingulate cortex, medial and lateral parietal cortex, dorsolateral and ventrolateral prefrontal cortex, and the medial temporal lobe. Source memory effects (Correct>Incorrect source) overlapped with the recall effects in several regions, including retrosplenial/cingulate, lateral parietal, and parahippocampal cortex. No regions demonstrated effects unique to source retrieval. The findings suggest that cued recall and source recollection depend on a common retrieval network.

I54

REDUCED THE VIVIDNESS OF MEMORY FOR COMPLEX STIMULI AND AUTOBIOGRAPHICAL EVENTS IN PATIENTS WITH TEMPORAL LOBE EPILEPSY OR EXCISIONS Marie St-Laurent[1,2], Morris Moscovitch[1,3], Mary Pat McAndrews[1,2]; [1]University of Toronto, Canada, [2]Krembil Neuroscience Program, Toronto, Canada, [3]Rotman Research Institute, Toronto, Canada — Unilateral medial temporal lobe epilepsy (TLE), a condition that affects the integrity of the medial temporal memory system, reduces the level of details of memory for personal episodes, or autobiographical memories (AM). Perceptual details, such as visual scene elements, sounds, and physical sensations, are especially prone to disruption. We assessed whether vivid and non-vivid episodic memories are equally affected by TLE, and whether this can be linked to their loss of AM vividness. We compared AM to memory for complex stimuli (short stories) studied in the laboratory in TLE patients and healthy controls. At encoding, the stories were shown under two different formats: as audio-visual film clips (vivid), and as written narratives presented with a voice over (non-vivid). At retrieval, participants were instructed to reflect on their memory for the personal event or story for 16s, after which they described the content and vividness of their retrieval experience using scales and free recall. A preliminary analysis reveals a large deficit in perceptual details in both the AM and the vivid story condition in our patients. While healthy controls retrieved a greater number of perceptual details in the vivid condition than they imagined in the non-vivid condition, this increase was reduced for TLE patients. These results support previous evidence that TLE disrupts the neural circuitry supporting the integration of vivid details into complex scenes.

I55

DISTINGUISHING THE ROLES OF PARAHIPPOCAMPAL CORTEX AND HIPPOCAMPUS DURING OBJECT-SCENE RECOGNITION Devin Duke[1], Chun-Yu Lin[2], Kevin Kawa[2], Lynn Nadel[2], Lee Ryan[2]; [1]University of Western Ontario, [2]University of Arizona — Hayes et al. (2007) demonstrated that object recognition decreases when objects are studied in a semantically-related scene and then tested on a white background, compared to objects tested in the same context. During study, parahippocampal cortex (PHC) activated during object-scene presentation and predicted subsequent object recognition. PHC also re-activated during recognition testing, even when objects were tested on a white background. These results suggested that PHC contributes to object-scene binding and acts to reinstate that scene context during subsequent retrieval, even when the context is no longer present. Left unanswered by this study is whether PHC binds the specific object-scene pairs, or whether PHC activates when an object is presented in any semantically-related scene, regardless of the specific visual details of that scene (suggested by Bar & Aminoff, 2003). The present fMRI study involved young adults making old/new recognition judgments for objects studied in semantically-related scenes and then tested in four context conditions: i) the identical scene, (ii) a novel but equally related scene, (iii) a familiar (old) but recombined scene, or iv) a white background. During recognition, PHC activity was equivalent for all three object-scene test conditions, regardless of whether the original object-scene pair was presented. In contrast, bilateral hippocampus activated optimally when the object was presented once again in the identical scene, compared to a familiar but recombined scene. These findings suggest that PHC may respond to objects presented in any semantically-related scene, while hippocampus codes for visually-specific object-scene pairs.

I56

SCAN ME ONCE, SCAN ME TWICE: EFFECTS OF REPEATED RETRIEVAL ON NEURAL CORRELATES OF RECENT AND REMOTE EPISODIC AUTOBIOGRAPHICAL MEMORIES Hedvig Soderlund[1], Morris Moscovitch[2,3], Namita Kumar[2], Marina Mandic[2], Brian Levine[2,4]; [1]Uppsala University, Sweden, [2]The Rotman Research Institute, Toronto, Canada, [3]University of Toronto, Canada, [4]University of Toronto, Canada — Retrieving an episodic autobiographical memory repeatedly may change the neural underpinnings of that memory. Also, this change may differ between recent and remote memories, with remote memories being more stable across repeated retrieval than recent memories. To assess the effect of repeated retrieval overall and as a function of memory age, we scanned participants with fMRI on two occasions (61±17 days apart) while they retrieved similar memories of varying remoteness. The memories recalled were of the same events, although of two different aspects of the event. An overall effect of repeated scanning was observed in the right hemisphere in mainly the inferior parietal lobe, lingual gyrus and the precuneus because of less activity during the second scan. Little change in neural correlates was observed for the most recent memories (1 week old at 1st scan; ~2 months old at 2nd scan) and the most remote memories (10 years old); much change was observed for the intermediately old memories that were 1 month old and, to a smaller extent, 1 year old. These changes included various regions of the autobiographical memory network, but not the hippocampus. Implications for theories of system consolidation will be discussed.

I57

SOURCE INFORMATION RETRIEVAL IN A RECOGNITION MEMORY TASK Matthew V. Mollison[1], Tim Curran[1]; [1]University of Colorado at Boulder — In a dual-process framework, two processes are involved in successful recognition memory: recollection involves the retrieval of specific information from the study episode, and familiarity supports recognition without the retrieval of details. The differences between these processes have been examined using correlated patterns of activity in the electroencephalogram (EEG). Event-related potentials (ERPs) dissociate between these recognition memory processes, specifically with an early (approximately 400 ms) frontal effect relating to familiarity (the FN400) and a later parietal (500-700 ms) effect relating to recognition. It has been debated whether source information for a studied item (i.e., contextual information from when the item was previously encountered) is only accessible through recollection, or whether familiarity can contribute to successful source recognition (Ratcliff et al., 1995). These alternatives were examined in experiments involving source memory judgments for pictures of common objects. Experiment 1 revealed results inconsistent with the idea that only recollection supports retrieval of correct source information: the FN400 ERP component was significantly different between trials associated with correct and incorrect source judgments. Here, source information were arbitrary contextual associations presented visually (screen side and border color). Source information in Experiment 2 was defined according to the encoding task that subjects completed during the study list (size or living/nonliving judgments), and the FN400 did not differ between correct and incorrect source retrieval. These results suggest that the contribution from familiarity depends on the type of source information available, with familiarity being more likely to contribute when the source attributes are perceptually defined.

I58

DEFICITS IN PAST REMEMBERING EXTEND TO FUTURE IMAGINING IN DEVELOPMENTAL AMNESIA Nicole Carson[1,2], Donna Kwan[1], Donna Rose Addis[3], R. Shayna Rosenbaum[1,2]; [1]York University, Toronto, Canada, [2]Rotman Research Institute, Baycrest, Toronto, Canada, [3]The University of Auckland, New Zealand — Neuroimaging and patient studies report that the ability to remember one's past episodes and the ability to envision one's future episodes are tightly interconnected. Remembering past personal events and imagining personal future events recruit common brain areas, and loss of the former ability is typically accompanied with loss of the latter. However, it is unknown whether the same pattern holds true in individuals with developmental amnesia who have never had the ability to fully re-experience their personal past but who are nonetheless capable of semantic learning. To test whether the development of episodic memory is necessary for episodic future imagining, we tested a developmental amnesic person with bilateral hippocampal loss and demographically matched controls on an adapted version of the Autobiographical Interview that included a Galton-Crovitz-like cueing method. Participants were given a cue word and instructed to either recall a past personal event or generate a novel future personal event. Transcriptions of the narratives were segmented into internal (episodic) vs. external (non-episodic) details. Narratives were also assigned qualitative ratings to reflect the overall episodic richness of the generated event. The developmental amnesic person showed a parallel pattern of impairment for both past and future event generation, such that narratives of both types of events were similarly deficient. These results indicate that mental time travel is compromised in hippocampal amnesia, whether acquired in early or later life.

I59

RECOLLECTION ORIENTATION, RETRIEVAL SUCCESS, AND TASK DIFFICULTY: THE ROLE OF PREFRONTAL CORTEX AND POSTERIOR PARIETAL CORTEX DURING SOURCE AND ITEM MEMORY Scott M. Hayes[1,2], Norbou G. Buchler[3], Jared Stokes[4], James Kragel[4], Roberto Cabeza[4,5]; [1]Memory Disorders Research Center, Neuroimaging Research Center, Boston VA Healthcare System, [2]Boston University School of Medicine, [3]U. S. Army Research Lab, Aberdeen Proving Ground, [4]Center for Cognitive Neuroscience, Duke University, [5]Brain Imaging and Analysis Center, Duke University Medical School — The role of prefrontal cortex and posterior parietal regions in memory retrieval is hotly debated. In the current paradigm, we used functional Magnetic Resonance Imaging (fMRI) to investigate the neural correlates of recollection orientation and success in item and source memory under 'easy' and 'hard' retrieval conditions. Young adults studied words once (hard condition) or twice (easy condition) while making either a pleasant/unpleasant or bigger/smaller than a shoebox judgment. For the item memory task, participants were presented with studied and unstudied words, and made an old/new judgment. For source memory, participants saw studied words and indicated which study task (pleasant/unpleasant or bigger/smaller) was associated with the word. Corrected recognition scores revealed equivalent item and source performance and a main effect of difficulty (Easy > Hard). fMRI analyses of recollection orientation, Source > Item, revealed striking left-lateralized activation in lateral prefrontal, dorsal parietal cortex, middle temporal gyrus and retrosplenial cortex. Importantly, these activations were not attributable to retrieval difficulty, as the same left-lateralized network was active in the Source Easy > Item Hard comparison, in which retrieval accuracy was matched. The results are consistent with the notion that these regions play a role in recollection orientation, and are not related to retrieval difficulty. Analysis of Source > Item high confidence hits revealed additional activation in right lateral prefrontal cortex. Finally, comparison of Hard > Easy trials revealed activation in bilateral ventrolateral and dorsolateral prefrontal regions, dorsal parietal cortex, and visual cortex, reflecting top-down control processes necessary for more challenging cognitive tasks.

I60

THE NEURAL CORRELATES OF VARYING DEGREES OF IMAGEABILITY John G. Smolinsky[1,2], Hector Y. Adames[1,2], Andrew E. Budson[1,2], Brandon A. Ally[1,2]; [1]Center for Translational Cognitive Neuroscience, Bedford VA Hospital, MA, [2]Boston University — Recalling previously learned material is influenced by our experience with that information at encoding. Previous research has shown that easily imaged words are better recalled than words that are not easily imaged. Understanding techniques that increase recognition can help direct interventions to improve memory in older and clinical populations. The goal of the current study was to examine how increasing word imageability affects the neural correlates of recognition memory. Event-related potentials (ERPs) were used to examine changes in the underlying brain physiology associated with the retrieval of words across three different degrees of imageability. We expected that as word imageability increases, the putative correlate of memorial recollection would be enhanced. Subjects were instructed to create visual images for each of the words presented before advancing during the self-paced study phase. Consistent with previous findings, the behavioral results demonstrated that memorial accuracy increased as word imageability increased. Also reaction times decreased both at study while creating a mental image, and at test as word imageability increased. Consistent with our apriori hypotheses, posterior brain activity between 500 and 900 ms post-stimulus associated with memorial recollection was enhanced as word imageability increased. We speculate that increasing the degree of word imageability actually increases the individual's subjective experience of remembering. These findings have several implications for future research and possible clinical interventions for memory impaired populations. Future research will investigate whether these neural correlates will differ between younger and healthy older adults, as well as those living with Alzheimer's disease.

I61

DISSOCIATING DECISION-MAKING PROCESSES DURING SOURCE MEMORY RETRIEVAL USING FMRI PATTERN ANALYSIS Alan Gordon[1], Jesse Rissman[1], Corbett Bennett[1], Anthony Wagner[1]; [1]Stanford University — Source memory retrieval is thought to require multiple neurocognitive processes. These include the accumulation of mnemonic evidence in relation to decision criteria and the subsequent implementation of an appropriate motor response. In the present study, we used fMRI multivoxel pattern analysis to examine how these processes differentially relate to fronto-parietal activation during source memory decisions. During each encoding trial, subjects encountered an adjective and generated either a face or scene described by that adjective, thus giving rise to patterns of neural activity associated with word-face or word-scene encoding. During each retrieval trial, subjects were re-presented with the words encountered in the encoding phase and were asked to indicate with a left or right button press which of the two source tasks (face or scene) was associated with each word. One multivoxel pattern classifier was trained to distinguish patterns of distributed BOLD activity associated with the two encoding tasks, and a second pattern classifier was trained to distinguish patterns of BOLD activity associated with left vs. right button presses. These two classifiers were then presented the BOLD data from retrieval, enabling quantitative measures of the degree to which (a) mnemonic evidence for the face and scene encoding patterns were present during each retrieval trial, and (b) cortical regions relevant to the response selection were recruited during each retrieval trial. Analyses revealed that left dorsolateral PFC and intraparietal sulcus tracked mnemonic evidence, rather than response evidence, implicating these fronto-parietal structures in decision-level processes during retrieval.

I62

WORDS AND PICTURES GIVE RISE TO DIFFERENT NEURAL CORRELATES OF RECOLLECTION: EVIDENCE FROM EVENT-RELATED POTENTIALS (ERPS) Ida-Maria Skavhaug[1], Edward L. Wilding[2], David I. Donaldson[1]; [1]University of Stirling, [2]Cardiff University — The Event-Related Potential (ERP) left-parietal old/new effect is widely believed to index generic recollection-based memory retrieval processes. The view that this is the only ERP index of recollection, however, is inconsistent with recent reports of an anterior distribution for recollection for faces (MacKenzie and Donaldson, 2007; 2009). This anterior recollection effect occurs in the same time period in which left-parietal ERP old/new effects are commonly observed, even when using identical operational definitions of recollection for words and faces. Here we further investigate the material specificity of recollection. We have previously shown that the left-parietal effect is modulated by Judgments of Learning (JOLs; estimations of likelihood of future remembering, made during encoding); the higher the JOL, the larger the amplitude of the effect. The current experiments employed ERPs to examine retrieval of words (experiment 1) and pictures (experiment 2) using a JOL task. At study, participants made a JOL to each item. At test, they were re-presented with each studied item (along with unstudied items) and made an old/new recognition judgment to each. Correct recognition of words elicited the left-parietal ERP old/new effect, whereas pictures gave rise to a widespread effect with a focus over midline fronto-central recording sites in the same epoch (500-800ms). Importantly, these two effects were both modulated by the JOLs made at study (larger for high than for low JOLs), suggesting they index similar cognitive processes. These observations strongly support the view that the distribution of recollection-related activity is sensitive to stimulus materials.

I63

POOR SLEEP CONTRIBUTES TO POOR MEMORY CONSOLIDATION IN AMNESTIC MILD COGNITIVE IMPAIRMENT Carmen E. Westerberg[1], Susan M. Florczak[1], Eric M. Lundgren[1], Sandra Weintraub[1], M. Marsel Mesulam[1], Phyllis C. Zee[1], Ken A. Paller[1]; [1]Northwestern University — Recent findings show that sleep is important for the consolidation of declarative memories in healthy adults. Sleep disruptions are typical in Alzheimer's disease, but whether these disruptions contribute to memory impairment is unknown. Amnestic mild cognitive impairment (aMCI) is in many cases a prodromal form of Alzheimer's disease, characterized by declarative memory deficits without dementia. Sleep has not been formally characterized in aMCI. We studied sleep and memory in 10 aMCI patients and 10 age- and education-matched controls for 2 weeks. Sleep was monitored with wrist-worn activity sensors and daily sleep surveys. Memory was assessed with daily recognition tests for information acquired just prior to test (short-delay recognition) and on the previous day (24-hour recognition). Recognition was impaired and more variable in aMCI patients compared with controls, but the two groups did not differ on objective or subjective measures of sleep. In the aMCI group, however, recognition accuracy on the 24-hour test but not on the short-delay test was correlated with subjective sleep-quality reports. Furthermore, poorer recall performance assessed during a neuropsychological test battery prior to the 2-week protocol was associated with greater variability in objective sleep measures across nights in aMCI and control groups combined. The correlations observed here suggest that subjective ratings of poor sleep are indicative of deficient sleep-dependent memory consolidation in aMCI patients. Moreover, inconsistent daily sleep patterns may be detrimental to declarative memory. These findings will be extended by including physiological sleep measures in aMCI to provide further insight into declarative memory consolidation.

I64

PARIETAL CONTRIBUTIONS TO EPISODIC RETRIEVAL: EFFECTS OF MEMORY AND DECISION CRITERIA J. Benjamin Hutchinson[1], Melina R. Uncapher[1], Anthony D. Wagner[1]; [1]Stanford University — While neuroimaging studies of episodic retrieval have consistently revealed activation in posterior parietal cortex (PPC), there remains much debate about the functional roles of dorsal and ventral PPC regions in memory. A parallel literature implicates PPC in processes engaged during perceptual decision-making, suggesting similar processes may also contribute to episodic retrieval. The current fMRI study manipulated decision criteria in order to disentangle PPC responses associated with mnemonic evidence from responses associated with decision processes. Participants incidentally encoded visually presented words, and were subsequently scanned while performing two recognition memory tests. In the first test, a between-subject instructional manipulation varied whether participants made a 1-5 point confidence rating about item novelty or item familiarity. In the second test, participants performed a standard old/new recognition task (making old/new/unsure responses). PPC regions showing greater activation during hits vs. correct rejections (i.e., "old/new effects") on this latter test were interrogated for sensitivity to instructional framing in the confidence-rating test. Initial results suggest that old/new sensitive regions in the inferior parietal lobule, near the intraparietal sulcus, are insensitive to decision criteria. Additional a priori region of interest analyses suggest that a region within the superior parietal lobule tracks the decision uncertainty, whereas a region of angular gyrus demonstrates an inverse pattern. These findings underscore that multiple interacting processes within PPC contribute to episodic retrieval.

I65

AUTOMATIC AND STRATEGIC RECRUITMENT OF MTL DURING MEMORY AND NON-MEMORY TASKS Alexandra S. Atkins[1], Norbou Buchler[1], Ian G. Dobbins[2], Roberto Cabeza[1]; [1]Center for Cognitive Neuroscience, Duke University, [2]Washington University, St. Louis — Recent work has demonstrated that medial temporal regions can distinguish new from studied items independently from retrieval success. The present experiment examined the influence of task context and top-down attention on automatic versus strategic recruitment of MTL regions. Using event-related fMRI, we compared neural activity associated with old and new items presented during a non-memory lexical decision task and an intentional item recognition task. During intentional recognition, we manipulated top-down attention to old or new items by instructing subjects to either "focus on finding old words" or "focus on finding new words" on alternating task blocks. Apart from this instruction, these task blocks were identical. Neuroimaging results for the lexical decision task show increased activation in the right hippocampus associated with previously studied relative to novel word items, demonstrating automatic stimulus-driven MTL activity can dissociate old from new items regardless of intention. Results from the intentional item recognition task show that MTL activity can also be strategically mediated by top-down influences of attention. Although behavior was equivalent across focus old and focus new recognition blocks, comparisons between these conditions revealed strategic modulation of bilateral MTL regions. Compared to focus new, the focus old condition was associated enhanced posterior MTL responses to old items and attenuated anterior MTL responses to new items. Taken together results suggest that MTL can be recruited automatically and in the absence of intentional retrieval. When there is intent to retrieve, patterns of MTL activation may be strategically modulated by retrieval-specific task goals.

I66

ASSOCIATIVE AND INTEGRATIVE PROCESSING DURING MEMORY ENCODING OF ABSTRACT FIGURES Erik A. Wing[1], Scott M. Hayes[2], Maureen E. Ritchey[1], Roberto Cabeza[1]; [1]Duke University, [2]Boston University School of Medicine — Episodic recognition encompasses memory for both individual items and for the associations between items, which may be supported by distinct regions in the medial temporal lobes (MTL) and prefrontal cortex (PFC). One account holds that the hippocampus is critically involved in forming associations between discrete items, while the rhinal cortex mediates item memory. Recently, it has been suggested that the perirhinal cortex may contribute to associative encoding when information can be integrated into unitized representations. To examine this distinction between integrative and associative processes, we collected fMRI data during recognition memory encoding. At study, subjects viewed pairs of abstract shapes that were spatially overlapping, encouraging integration, or non-overlapping, relying more on association. Stimuli from the two conditions were perceptually very similar. At test, subjects made old/new recognition judgments that were used to classify encoding trials as subsequently remembered or forgotten, thus permitting analysis of encoding success activity (ESA). Both conditions engaged ESA in attentional and perceptual networks, including dorsolateral PFC, dorsal parietal regions, and occipital cortex, indicating common perceptual processing and engagement of top-down attention. Despite the marked similarities between conditions, differences in ESA were identified in anterior PFC and MTL. Association elicited increased ESA in bilateral hippocampus and left PFC compared to integration, whereas integration revealed greater ESA in rhinal cortex and right PFC. Hemispheric lateralization may reflect differential involvement of semantic versus heuristic processes; likewise, MTL results support a dissociation between hippocampal and rhinal contributions to association and integration.

I67

SCHIZOPHRENIA PATIENTS SHOW DIFFERENCES IN ACTIVITY OF NEURAL SYSTEMS UNDERLYING ASSOCIATIVE MEMORY ENCODING Alexander Leung[1], Paul Metzak[1], Todd Woodward[1]; [1]University of British Columbia — We sought to reveal functionally connected neural networks mediating associative memory encoding, and examine differences between schizophrenia patients and control subjects. While undergoing functional magnetic resonance imaging, 26 schizophrenia patients and 26 control subjects completed 90 association tasks (i.e., they were provided a cue word, and were required to choose the more strongly associated of two companion words). Following scanning, subjects were asked to free-recall and cue-recall the word pairs viewed in the scanner. Using constrained principal component analysis with a finite impulse response basis set, three statistically significant components of neural activity emerged. Component 1 involved activity in left inferior parietal lobe, left superior temporal gyrus, bilateral visual cortices and dorsal anterior cingulate cortex (dACC). Component 2 showed activity in dACC/supplementary motor area, visual cortices, and left premotor cortex. Component 3 showed deactivation in medial prefrontal cortices and posterior cingulate/precuneus. For all components, encoding words that were later not recalled was associated with higher activation or deactivation than encoding free- or cue-recalled words; and encoding cue-recalled words showed higher activation or deactivation than encoding free-recalled words. For components 1 and 3, schizophrenia patients exhibited less activation or deactivation than control subjects when encoding cue-recalled words ($p < .05$). Greater activity when encoding non-recalled words, or those only recalled when cued, may reflect increased difficulty or interference at the encoding stage. The differences in activity of these components observed in schizophrenia patients may help elucidate the variations in associative memory function thought to underlie many characteristic features of this disease.

I68

USING ELECTROPHYSIOLOGY TO DISTINGUISH FAILED AND SUCCESSFUL SPATIAL ENCODING AND NAVIGATION Krysta Chauncey[1], Tad Brunye[2], Audrey Girouard[1], Robert Jacob[1]; [1]Tufts University, [2]Natick Soldier Research Development and Engineering Center — Electrophysiology in its wide variety of analysis types (ERD/ERS, ERPs, spectral analysis, etc) can provide some of the most detailed and direct insight into cognitive functions currently available; in this work, it is used to distinguish failed from successful spatial encoding and navigation. Participants were shown a map of a virtual space they were subsequently asked to navigate, and EEG data collected both while they were viewing the map and while they were navigating the space. Increases in positive activity between 400-700ms during study periods that resulted in successful navigation were seen, and long-scale increases in positive activity were seen during successful navigation periods. This supports the hypothesis that differences in brain activity at encoding determine retrieval status and are repeated during retrieval; these findings will be discussed in the context of current models of spatial representation and memory.

I69

REACTIVATION OF PRIOR EXPERIENCE DURING ENCODING OF OVERLAPPING EVENTS SUPPORTS GENERALIZATION Dagmar Zeithamova[1], Alison R. Preston[1]; [1]University of Texas at Austin — The ability to generalize past experience to answer novel questions is a powerful characteristic of memory. One process supporting generalization, integrative encoding, postulates that overlapping experiences are linked into integrated representations during learning. Overlapping information shared across events may elicit recall of prior experience, enabling integration of new experience into existing representations. However, evidence for such reactivation during encoding remains speculative. Here, we used functional MRI to test whether reactivation of content specific representations occurs during encoding of overlapping events in service of generalization. During an associative inference paradigm, object (O) and scene (S) stimuli were organized into triads containing a single stimulus type (3 objects: OOO, 3 scenes: SSS) or cross-domain content (OOS, SSO). During functional scanning, participants encoded overlapping pairs from each triad (e.g., pretzel-frog, frog-beach) across multiple interleaved repetitions and were subsequently tested on the inferential relationship between items (e.g., pretzel-beach) after scanning. Using a localizer task, univariate region of interest analysis and multivoxel pattern analysis identified content-specific brain regions involved in scene and object encoding. We then compared encoding activation for pairs of the same content (e.g., SS) where the content of the unseen triad member differed (scenes in SSS vs. objects in SSO), observing reactivation of content-specific networks reflecting unseen content that increased across repetition. Univariate analyses further demonstrated activation in content-general regions that increased across learning regardless of information content. Together, these results provide evidence for an underlying mechanism supporting the integration of overlapping events during learning enabling generalization beyond individual experiences.

I70

RECOLLECTION HAS A THRESHOLD: DIRECT EVIDENCE FROM A NOVEL SOURCE TASK Iain M. Harlow[1], David I. Donaldson[2]; [1]University of Edinburgh, [2]University of Stirling — By a dual-process view, episodic retrieval is supported by two functionally dissociable processes, familiarity (an acontextual sense of oldness) and recollection (retrieval of details about a specific episode). Familiarity is widely agreed to be graded, in contrast there is considerable disagreement over how recollection should be characterized: as a thresholded process that can either succeed or fail, or, like familiarity, one which provides some strength on all trials. Most previous research addressing this question has focussed on the distribution of confidence judgments, i.e. participants' own assessment of their memory strength, for a choice between two fixed options (such as 'old' and 'new'). Here we adopt an alternative approach, measuring the accuracy – hence strength – of recollection directly using a graded source task. Participants memorized word-location pairs. At test they were cued with the same words, selected the corresponding location as precisely as possible, and rated their confidence. The distribution of accuracies (how close responses were to the correct location) was closely fit by a thresholded model, whereby around half of responses were guesses and the other half were essentially accurate. Interestingly, the same data can appear graded when assessed using confidence-based receiver-operator characteristic (ROC) curves - illustrating the limitations of that method despite its ubiquity in the field. Our results appear to confirm a central but hotly disputed property of recollection, providing an important constraint for models of memory: while the quality of source information may vary slightly from episode to episode, its retrieval is fundamentally thresholded.

I71

DIFFERENTIAL NEURAL ACTIVITY DURING RETRIEVAL OF SPECIFIC AND GENERAL AUTOBIOGRAPHICAL MEMORIES DERIVED FROM MUSICAL CUES Jaclyn Hennessey[1], Donna Rose Addis[2], Kelly Giovanello[1]; [1]University of North Carolina at Chapel Hill, [2]University of Auckland — Previous studies have sought to identify the neural underpinnings of specific and general autobiographical memory retrieval. Many of these studies have utilized cues associated with prior retrievals of the event, potentially changing the retrieval processes being investigated. In the current study, musical cues were used to naturally elicit memories from multiple levels of specificity (i.e. lifetime period, general event, and event-specific). Sixteen young adults participated in an fMRI study in which they retrieved autobiographical memories associated with the musical cues. Musical cues led to the retrieval of highly emotional memories that had low levels of prior retrieval. Owing largely to the use of music, memories from the three levels of specificity were retrieved in equal numbers, allowing for comparison of memory characteristics and neural correlates of retrieval. Subjects rated vividness, emotional intensity, and re-experiencing as greater for event-specific compared to general memories. Additionally, these memories were associated with increased activation in regions within the core autobiographical memory network, such as the hippocampus, thalamus, and visual processing regions. However, other regions within the network, such as the medial prefrontal cortex and posterior cingulate, were activated during all autobiographical memory conditions. The results of this study suggest that regions in the autobiographical memory network may be involved in different processes during retrieval, some being engaged during all autobiographical retrieval conditions and others that being preferentially engaged during retrieval of event-specific memories.

I72

A GENETIC VARIATION OF THE NORADRENERGIC SYSTEM IS RELATED TO DIFFERENTIAL AMYGDALA ACTIVATION DURING ENCODING OF EMOTIONAL MEMORIES Bjoern Rasch[1,2], Klara Spalek[1,2], Sarah Buholzer[1,2], Roger Luechinger[3], Peter Boesiger[3], Andreas Papassotiropoulos[2], Dominique de Quervain[1]; [1]Division of Cognitive Neuroscience, University of Basel, [2]Division of Molecular Pychology, University of Basel, [3]Institute for Biomedical Engineering, University and ETH Zürich — Emotional events are better remembered than neutral events. The memory enhancing effect of emotional arousal critically depends on noradrenergic activation of the amygdala. We have recently shown that a functionally relevant deletion in a gene coding the adrenergic receptor (?2B-adrenoceptor) enhances emotional memory in healthy humans and traumatic memory in war victims. Here we show using functional magnetic resonance tomography (fMRI) that healthy carriers of the deletion variant exhibit a marked increase in activation of the amygdala during encoding of emotional pictures as compared to no deletion carriers. The genotype-dependent differences in brain activity during encoding of emotional events may underlie the increased emotional memory and vulnerability to traumatic memories in deletion carriers.

I73

MEMORY CONSOLIDATION DURING A DAYTIME NAP Simone Duss[1], Oliver Markes[1], Thomas Reber[1], Simon Ruch[1], Daniel Oppliger[1], Johannes Mathis[1], Corinne Roth[1], Katharina Henke[1]; [1]University of Bern — A heatedly discussed issue in sleep research concerns the beneficial effects of sleep on the retention of information learned before sleep: is this effect due to active consolidation processes or due to the lack of interference during sleep? In our experiments, subjects incidentally learned either face – written city combinations or single faces before a daytime nap or a relaxation training. Subjects retrieved half of the learning material before and half following the 90 min. study-test interval filled with sleep or relaxation. For retrieval, faces were presented alone for the cued recall of the associated cities. Single face retrieval was assessed with a recognition test. Sleep benefited the retention of both face-city associations and faces (d'). The relaxation group forgot more associations and faces over the 90 minutes study-test interval than the sleep group. A median split revealed that only those subjects within the nap group with long slow-wave sleep durations (over 17 minutes) could retain much of the learned information. Subjects with less slow-wave sleep forgot significantly more information. Total sleep duration did not correlate with any of the pre-post memory score differences. At follow-up testing between three and six months after the experiment, the nap group still showed above chance retrieval performance. Memory retention was probably supported by an active consolidation process rather than lack of interference during sleep because retrieval was better in the nap group than in the low-interference relaxation group, and because only subjects who spent much time in slow-wave sleep retained the learned information.

I74

SELECTIVE FAMILIARITY IMPAIRMENTS IN TEMPORAL LOBE EPILEPSY WITH DÉJÀ VU Chris Martin[1], Seyed Mirsattari[1], Brent Hayman-Abello[1], Jorge Burneo[1], Stefan Köhler[1]; [1]University of Western Ontario — Recognition memory is thought to rely on two component processes, i.e. familiarity and recollection. Recollection involves remembering contextual details from a specific past stimulus encounter. Familiarity, by contrast, gives rise to recognition without recovery of such contextual detail. We recently reported the case of NB, an individual who exhibits selective impairments in familiarity with preserved recollection after surgical treatment for intractable temporal-lobe epilepsy (TLE). Her rare resection included the left anterior temporal lobe with hippocampal sparing. Interestingly, prior to surgical intervention, NB experienced seizures that were accompanied by feelings of déjà vu. Déjà vu is an impression of familiarity that co-exists with a feeling of inappropriateness. Here, we examined whether ictal déjà vu in pre-surgical TLE patients is associated with lasting, impairments in familiarity similar to those observed in NB post-surgery. A remember-know task and an exclusion task for scenes were administered to TLE patients with déjà vu and to control participants. In both tasks, TLE patients with unilateral seizure focus exhibited a pattern of recognition memory performance that suggests selective familiarity impairments. In bilateral cases, by contrast, deficits were found to include impairments in recollection as well. Our findings show that selective familiarity deficits can be observed in cases other than NB. Moreover, they confirm the hypothesized link between déjà vu and experimental measures of familiarity assessment. The broader recognition impairment observed in bilateral cases suggests, finally, that intact recollection is not a prerequisite for identifying familiarity feelings as inappropriate in the context of ictal déjà vu experiences.

I75

CORRELATIONS BETWEEN BEHAVIOURAL PERFORMANCE AND MAGNITUDE OF HEMODYNAMIC RESPONSE PEAK IN CONTEXTUAL MEMORY TASKS IN SCHIZOPHRENIA PATIENTS AND HEALTHY CONTROLS Paul Metzak[1,2], Liang Wang[1,2], Elton Ngan[1], Todd Woodward[1,2]; [1]University of British Columbia, [2]BC Mental Health and Addicitions Research Institute — In the current study, we sought to investigate the neural networks that underlie successful contextual memory performance. While undergoing functional MRI scanning, 21 schizophrenia patients and 21 healthy controls performed the recall portion of a contextual memory task in which they were asked to indicate which of four operations they had previously performed while encoding each word (reading, hearing, semantically associating, or unscrambling letters). Using a Finite Impulse Response (FIR) basis set modelling the peristimulus time points in conjunction with constrained principal component analysis (CPCA) for fMRI data, we extracted 3 functionally interacting but separate components. The first component was characterized by activations in "task positive" regions including occipital cortex, medial supplementary motor /dorsal anterior cingulate cortex, and sensori-motor cortical regions. The second component was characterized by decreased activation in “task negative” regions, including medial prefrontal cortex and precuneus and posterior cingulate cortex. The third component was characterized by activations in the dorsolateral prefrontal, orbitofrontal, and dorsal anterior cingulate cortices. Subsequent analyses revealed that, in the healthy controls, performance accuracy was significantly correlated with the estimated peak hemodynamic response for component 1, whereas, for the schizophrenia patients, performance accuracy was significantly correlated with the estimated hemodynamic response peaks for both component 1 and component 2. The difference between the patient and control samples correlations on component 2 was also found to be significant. This analysis suggests that schizophrenia patients require coordinated activity in these two neural systems in order to successfully complete contextual memory recall tasks.

I76

SEMANTIC GENERATION INDUCES EPISODIC FORGETTING: AN EVENT-RELATED POTENTIAL STUDY Mikael Johansson[1], Robin Hellerstedt[1], Sofie Nilsson[1]; [1]Lund University — Selective memory retrieval is considered to involve inhibitory control mechanisms recruited to overcome interference from competing memory representations. A consequence of such control is that the inhibited memories are reduced in their accessibility and forgotten on subsequent memory tests. In the present event-related potential (ERP) study, we investigated the neural correlates of inhibitory control and later episodic forgetting by varying levels of interference during selective semantic memory retrieval. After having studied items from different categories (e.g. FRUIT-Apple, DRINK-Water), subjects engaged in semantic generation of unstudied items from half of the categories (e.g. FRUIT-M___), and were finally asked to recall all studied items. Generation-induced forgetting (GIF) was observed in impaired recall of studied items from categories included in the generation task as compared to studied control items (e.g. DRINK-Water). Importantly, the GIF effect was larger when the semantic generation task was characterized by a high level of interference caused by the studied, competing items (strong versus weak category-item association strength), i.e., GIF was interference-level dependent. Analysis of ERPs recorded during the semantic generation task revealed a sustained, more positive-going modulation in the high- compared to the low-interference condition at anterior frontal sites. Further analyses showed that this frontal positivity was predictive of individual differences in the amount of GIF observed in the final memory test. These results extend previous research by showing a relationship between frontal ERPs during selective retrieval and later forgetting when contrasting conditions within the same retrieval task, and are consistent with an inhibitory-control account of generation-induced forgetting.

I77

BEHAVIORAL AND FUNCTIONAL ANALYSIS OF OBJECT, SPATIAL, AND TEMPORAL MEMORY Ruth M. Johnson[1], Stephanie J. Babb[1]; [1]University of Houston-Downtown — This study characterized the cortical mechanisms for processing episodic memory using behavioral criteria of what (object), where (spatial arrangement), and when (temporal order). In separate behavioral and functional experiments, participants were shown a total of 80 unique visual scenes of the interiors of furnished homes across four blocks of 20 trials each. After viewing 20 visual scenes for 4 seconds each, participants were randomly given 5 trials of each of the four conditions (What, Where, When, and Control). Participants' accuracy and reaction time was examined with respect to memory for what, where, and when. Behavioral data showed that performance was highest and reaction time was fastest for the What condition. Twelve subjects participated in a functional magnetic resonance imaging (fMRI) experiment which was identical to the behavioral paradigm. Activations in both the medial temporal lobe and the frontal lobe were found across the different components of the memory task. Our results support theories consistent with involvement of the frontal and medial temporal regions in episodic memory retrieval and the hippocampal complex in recall of spatial memory. Further research should be able to distinguish previously unknown subcomponents of this extended network of brain areas by their differential activation across the three components of episodic memory (what, where, and when).

Perception & Action: Other

I78

JOINT ACTION IN A NEARLY NATURAL SITUATION. AN INVESTIGATION WITH FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (FNIRS) Johanna Egetemeir[1], Prisca Stenneken[1], Andreas J. Fallgatter[2], Martin J. Herrmann[2]; [1]Bielefeld University, [2]University of Würzburg — Many everyday situations require humans to execute actions together with a partner. Imagine carrying a big table, playing soccer or assembling furniture. Which brain mechanisms underlie the engagement in such joint actions? And how can you investigate this question in a nearly natural joint action situation with the interaction partners sitting next to each other? fNIRS measures hemodynamic change (deoxygenated, oxygenated, total hemoglobin) with 10-Hz temporal resolution. This method is quiet, portable and tolerates movement. It therefore allows the measurement of brain activity in nearly natural situations. Subjects had to execute object-related grasping and displacing movements, namely setting a table. They either executed the task alone (solo action), together with a partner (joint action) or observed the partner executing the action (action observation). Brain activation was measured with a 52-channel NIRS system (Hitachi ETG-4000). Compared to the solo action, the joint action task elicited a stronger activation in regions of the inferior parietal cortex and frontal cortex. Our results are compatible with previous findings on joint action which suggest involvement of the human mirror system in joint action. This study also demonstrates that fNIRS allows the investigation of brain activation in nearly natural joint action situations. We use these insights in an ongoing fNIRS study investigating the brain activation of two subjects in parallel while they are involved in a joint action task. We expect this new methodological approach to shed light on the temporal aspects of joint action.

I79

CRITICALITY IN VISUAL PERCEPTION AS REVEALED BY REVERSIBLE FIGURES Daniel S. Kislyuk[1]; [1]Helsinki University of Technology, Finland — Neural network is termed to be in the critical state when it balances close to phase transition between sporadic activations of individual neurons and massive avalanches of activity. Modeling studies demonstrated that in critical state information storage and sensitivity to sensory stimuli are optimal. Characteristic to criticality is the power law distribution of observables. While criticality was found in oscillations in neural slices and MEG in behavior the evidence is scarce. In this study participants were presented sequentially with Necker cube (Aks & Sprott, 2004) and face-vase reversible figures. Participants fixated on a black dot placed in the center of a figure. Cued with a sound participants reported, by pressing one of the buttons, which version of the figure they were perceiving. Times between the perception flips were calculated and their distribution had a classic power-law shape. To prove that power-law was the best fitting distribution the algorithm of Clauset, Shalizi & Newman (2009) was used. Distribution parameters (exponent and cut-off value) were estimated from the data, then the power-law's goodness-of-fit was calculated, and finally power-law was compared in its explanatory power with alternative distributions via a likelihood ratio test. For both reversible figures power law appeared to be the best fit. This suggests that the systems underlying the visual perception not only of depth, but also of object identification, might be in the state of criticality. During regular perception critical state of the visual processing systems might secure fast reaction to incoming stimuli, especially those of low intensity.

I80

OBSERVING THE "UNKNOWN" HYPER-ACTIVATES THE ONLOOKER'S MOTOR SYSTEM Mirta Fiorio[1], Wei Zhang[2], Paola Cesari[1], Maria Carla Bresciani[1], Giampaolo Rodi[1], Mattia Gambarin[1], Michele Tinazzi[1]; [1]University of Verona, [2]Tianjin Medical University and Hospital — In everyday life we may encounter actions schemes difficult to understand because they clearly deviate from typical expected kinematics, as in instances of actions performed by someone affected by a movement disorder. These non-fluent movements appear as puzzling to naïve eyes, whereas they are recognised and understood by patients affected by the same disease, as well as by clinicians, who are trained to detect abnormal signs. How does the lack of knowledge about observed actions modulate the onlooker's motor system? Three groups of subjects were recruited, with different visual expertise on a particular kind of action, i.e. writer's cramp, a dystonic movement. Group 1 (Naïf): 8 subjects without expertise and previous exposure to the view of dystonic writing. Group 2 (Neurologists): 8 qualified neurologists working in the movement disorder divisions and dealing with dystonic patients. Group 3 (Patients): 8 patients affected by writer's cramp. Single-pulse TMS was applied over the left M1 and motor evoked potentials (MEPs) were recorded from the FDI, AMD and FCR muscles, while subjects observed the following stimuli: 1) static hand; 2) healthy writing; 3) dystonic writing; 4) grasping. Naïves had higher FDI activation during observation of the dystonic writing compared to the healthy writing. Neurologists and patients did not show different corticospinal activation between the two writing conditions. Observing something unknown and never seen before might hyper-activate the onlooker's motor system. Visual expertise can modulate the motor cortex excitability during observation of pathological actions.

I81

FACE REPRESENTATION AND LEARNING: AN ERP STUDY Iris Gordon[1], James W. Tanaka[1]; [1]University of Victoria — In two experiments, we employed event-related potentials (ERPs) to investigate the acquisition of memory representations for familiarized faces. In Experiment 1, participants were required to monitor for a target "Joe" face amongst a series of distractor "Other" faces. At the half-way point, participants switched targets from the Joe face to a previous distractor "Bob" face. The ERP analysis focused on the posterior N250 component, indexing face familiarity, and the P300 component indexing context updating and response decision. Results showed that there was an enhanced N250 to the Joe face during the Joe/Other task, and to Bob during the Bob/Other task. Critically, an enhanced N250 to Joe was maintained during the Bob/Other phase even though Joe was no longer target. The P300 component also showed an enhanced activation to target faces, though the P300 to the Joe face during the Bob/Other task equaled that of the Bob face with both faces differing significantly from the Other face. In Experiment 2, we examined whether the increased N250 and P300 to Joe was due to simple naming effects. Participants underwent the same procedure as in Experiment 1 except this time they were introduced to both Joe and Bob faces and names at the beginning of the experiment. Results were similar to those of Experiment 1. These findings suggests that the N250 and P300 are not affected by name labeling, exposure or task-relevancy alone, but that a combination of these factors contribute to the acquisition of enduring face representations.

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RELATION OF QUANTITY DISCRIMINATION TO MATHEMATICAL ABILITY AT THE BEHAVIORAL AND NEURAL LEVELS Clancy Blair[1], Fredrik Tunvall[1], Alexandra Ursache[1], Hilary Knipe[1]; [1]New York University — The neural basis for the ability to discriminate quantity has been investigated extensively. The relation of quantity discrimination to proficiency in basic mathematics, however, is less well known. Twenty-two young adults discriminated visually presented (250msec) quantities at 1:2, 3:4, and 5:6 ratio limits while cerebral blood flow was measured using near infrared spectroscopy. Results indicated that accuracy across all quantity discrimination trials correlated positively with the number series, $r=.46$, $p<.05$, but not the quantitative concepts subtest of the Woodcock-Johnson Tests of Achievement-III. This correlation was attributable to performance on the 5:6 ratio limit trials, $r=.49$, $p<.05$. The neural response to quantity discrimination across all trials for 12 participants indicated increased oxygenated hemoglobin in left parietal and rostral frontal cortex that was best described by a quadratic term for time, R2=.78 and R =.80. Increase in oxygenated hemoglobin in these areas was greater than that observed in occipital cortex, paired $t=7.98$ and 9.91, $p< .0001$. Findings indicate that the ability to rapidly discriminate quantity is an aspect of proficiency in mathematical reasoning (number series) but not math knowledge (quantitative concepts). These findings indicate the need for further research to examine possible behavioral and neural associations between quantity discrimination abilities and working memory abilities that in combination contribute to mathematical reasoning ability.

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SHARED AFFECTIVE MOTION EXPERIENCE (SAME): A NEW MODEL OF EMOTIONAL MUSIC PERCEPTION Istvan Molnar-Szakacs[1], Katie Overy[2]; [1]UCLA, [2]University of Edinburgh — Based in the motor system, music shares combinatorial rules with action and language. Music can have profoundly moving effects on our imaginations, emotions and memories, but how such complex, abstract patterns of sound can communicate affective information remains unknown. We propose that the human mirror neuron system (MNS) may play a central role in this phenomenon, by allowing individuals to understand the meaning and intention of a communicative motor act, by evoking a representation of an observed action in their own brain. By linking perceptions and actions, the human MNS may provide a domain-general neural mechanism for processing rules of hierarchical combinations fundamental to language, action, and music, which in turn can communicate meaning and human affect. Considering this evidence, we have developed the Shared Affective Motion Experience (SAME) model of music perception, proposing that musical sound is perceived not only in terms of the auditory signal, but also in terms of the temporally synchronous, highly intentional, hierarchically organized sequences of expressive motor acts behind the signal. Features of this motion information are processed by the MNS, while the limbic system allows incoming information to be evaluated in relation to one's own autonomic and emotional state, leading to a complex affective response to music. Within the framework of the SAME model, we propose that music's potential to create shared, affective experiences - by jointly attending through imitation, synchronization, and shared experience - may be the key aspects of musical experience required for therapeutic and educational intervention activities.

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BOLD SIGNALS ASSOCIATED WITH THE PROCESSING OF GLOBAL AND LOCAL LANDMARKS IN HUMAN WAYFINDING BEHAVIOR Erik Chang[1], Chin-Teng Lin[2], Jen-Chuen Hsieh[3], Tzu-Chen Yeh[3], Teng-Yi Huang[2], Chou-Ming Cheng[3], Wen-Jing Lin[1], Li-Wei Ko[2], Ovid Tzeng[4], Daisy Hung[1]; [1]National Central University, Taiwan, [2]National Chiao Tung University, Taiwan, [3]Taipei Veterans General Hospital, Taiwan, [4]Academia Sinica, Taiwan — The ability to recognize and use landmarks is crucial for efficient wayfinding, yet how different types of landmarks are processed in the brain remains unclear. In the current study, we investigated the BOLD activities associated with two different types of landmarks while the participants were finding their ways between various combinations of starting and goal locations in a virtual maze environment. The landmarks examined were: 1) a global-landmark condition with huge architectures that surrounded the virtual maze and were visible from all locations, and 2) a local-landmark condition with cartoon pictures of common objects that were posted on the walls along the paths inside the maze and were only visible from certain locations. Participants were trained to be familiar with the layout of the maze and the goal locations before entering the 3T Bruker MRI scanner. BOLD signals were collected while the participants were performing the wayfinding task, and the results were analyzed with a random-effect General Linear Model in Brainvoyager®. Statistical contrasts revealed that navigation in the environment with global landmarks elicited higher activation in the left supramarginal gyrus, whereas navigation in the environment with local landmarks resulted in higher activation in the right temporal area. These results indicated that the processing of the global landmarks relied more on the left parietal region that computed the conversion between egocentric and allocentric coordinates, whereas the processing of the local landmarks relied more on the right temporal region that identify specific combination between icons and geometric structures.

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EXTRASTRIATE CORTEX AND MEDIAL TEMPORAL LOBE REGIONS CARE SIMILARLY ABOUT CATEGORY, BUT DIFFERENTIALLY ABOUT FEATURAL AMBIGUITY Matthew Mundy[1], Paul Downing[2], Kim Graham[1]; [1]School of Psychology, Cardiff University, [2]School of Psychology, Bangor University — Recent studies have highlighted differential patterns of activation in medial temporal lobe (MTL) regions for distinct classes of stimuli. While posterior hippocampus shows greater activation for scene discriminations (Lee et al., 2008), perirhinal cortex shows more activation during face and object discriminations (Barense et al., 2009). Similarly, extrastriate cortex is thought to contain a number of class-preferential regions (e.g. places - parahippocampal place area (PPA), faces - fusiform face area (FFA), and objects - lateral occipital cortex (LOC), Downing et al., 2006). It is unclear how these different areas interact to support processing of different stimulus types. For example, do regions that respond preferentially to faces (perirhinal cortex, FFA) show similar or different levels of activation? How are these patterns modulated by visual complexity or feature overlap? To address these questions, participants passively viewed images from four visual categories in a blocked fMRI design. Each category was presented at two levels of ambiguity (e.g., objects: fish (high ambiguity), mammals (low ambiguity)). There was evidence of a similar degree of categorical selectivity across MTL and extrastriate regions, consistent with previous studies. Extending these findings, it was found that while MTL regions (perirhinal cortex for objects and faces, and posterior hippocampus for scenes) showed more activity during passive viewing of featurally ambiguous blocks, extrastriate areas showed the opposite pattern. These findings are consistent with theoretical accounts that stress the importance of hierarchical processing in the ventral visual stream, and a contribution from MTL regions to perception and memory for complex conjunctive representations.

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AESTHETIC PERCEPTION AND APPRECIATION FOLLOWING RIGHT HEMISPHERE DAMAGE Bianca Bromberger[1], Rebecca Sternshein[1], Page Widick[1], William Smith II[1], Anjan Chatterjee[1]; [1]University of Pennsylvania — Looking at art is likely to be affected by brain damage. However, little about the neuropsychology of art perception is known. We hypothesized that perception of different attributes of art are likely to be disrupted by damage to different regions of the brain. Seventeen participants with right hemisphere damage were given the Assessment of Art Attributes Battery, a tool we designed to quantify descriptive characteristics of visual art. Each participant rated 24 paintings on 6 formal characteristics (depth, color temperature, color saturation, balance, stroke, and simplicity), 6 conceptual characteristics (depictive accuracy, abstractness, emotion, symbolism, realism, and animacy), as well as their preference for and interest in the paintings. Their ratings were compared with 60 young normal participants and scores were obtained for each brain-damaged participant for each attribute based on correlations with the normal group averages. These correlation scores were subjected to voxel-lesion-symptom mapping analyses. Using a false discovery rate of 0.05, we found that damage to areas within different parts of the frontal parietal and temporal cortices produced deviation in judgments of all six conceptual aspects of art. Of the formal attributes, only depictive accuracy and color temperature judgments were affected by dorsolateral prefrontal damage. Despite their deviations in assessing perceptual attributes of artwork, no areas of brain damage were associated with correlation deviations in judgments of preference or interestingness of these artworks.

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SPACE AND TIME IN PERCEPTUAL CAUSALITY Anjan Chatterjee[1], Benjamin Straube[2]; [1]University of Pennsylvania, [2]University Marburg — Inferring causality is a fundamental feature of human cognition that allows us to theorize about and predict future states of the world. Michotte suggested that humans automatically perceive causality based on certain perceptual features of events. However, individual differences in judgments of perceptual causality cast doubt on Michotte's view. To gain insights in the neural basis of individual difference in the perception of causality, our participants judged causal relationships in animations of a blue ball colliding with a red ball (a launching event) while fMRI-data were acquired. Parametric violations of spatial continuity and temporal contiguity were incorporated in these stimuli. We did not find consistent brain activation differences between trials judged as caused and those judged as non-caused, making it unlikely that humans have universal neural correlates of perceptual causality in the brain. However, participants were slower to respond to and showed greater neural activity for violations of causality, suggesting that humans do have a bias to expect causal relationships when moving objects appear to interact. Our participants demonstrated considerable individual differences in the sensitivity to spatial and temporal characteristics in perceiving causality. These qualitative differences in sensitivity to time or space in perceiving causality were instantiated in individual differences in activation of the left basal ganglia or right parietal lobe, respectively. Thus, the perception that the movement of one object causes the movement of another is triggered by elemental spatial and temporal sensitivities, which themselves are instantiated in specific distinct neural networks.

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THETA SYNCHRONIZES AS MU DESYNCHRONIZES DURING SENSORIMOTOR BEHAVIOR Leanna Cruikshank[1], Jeremy B. Caplan[1], Anthony Singhal[1]; [1]University of Alberta — Many types of behavior rely on sensory and motor systems coordinating their activity. The neurophysiological mechanism that facilitates this coordination however, remains unclear. Evidence from animal research has suggested that theta oscillations (3-12 Hz rhythmic brain activity) are a neural mechanism underlying sensorimotor integration in rats (Bland, 1986). However, it is not known whether and how this mechanism might extend to humans. Cortical theta has been reported over frontal-midline areas in the human EEG, yet research addressing its function has yielded varied results. Furthermore, the mu rhythm (8-12 Hz) is the chief rhythm implicated in human sensorimotor tasks. It is present during periods of stillness and decreases with movement. We hypothesized that neocortical theta is present during sensorimotor integration but has been overlooked due to the fact that mu and theta rhythms coincide spatially and are adjacent frequencies. Using a goal directed reaching paradigm, participants were auditorily cued to reach towards target dots appearing on a touchscreen while EEG activity was recorded. The highly reported mu rhythm was present prior to movement and desynchronized, giving way to more anterior theta oscillations during the movement. These findings are consistent with Bland's (1986) model of theta as a mechanism for sensorimotor integration and suggest that frontal-midline theta may mark integration more generally, potentially accounting for the broad range of complex cognitive tasks known to induce this rhythm in the absence of mu.

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THE PATH IS MORE IMPORTANT THAN THE DESTINATION: MOUSE-MOVEMENT TRAJECTORIES REVEAL THE TIME-COURSE OF SPATIAL, NUMERICAL AND RESPONSE CONFLICT Edward Hubbard[1], Arnaud Viarouge[1], Jonathan Vitale[2], Bruce McCandliss[1]; [1]Educational Cognitive Neuroscience Lab, Peabody College, Vanderbilt University, Nashville, TN, [2]Teachers College, Columbia University, New York — Although traditional reaction time (RT) measures can reveal hidden cognitive processes intermediate between perception and action, they also often collapse across processes that have both early versus late influences. Conversely, mouse-tracking permits continuous on-line measurement of the x- and y-coordinates of a mouse cursor, potentially revealing different temporal dynamics of multiple cognitive processes that influence a decision. Here we use mouse tracking to study two well-known spatial interference effects in combination – the Simon effect and the SNARC effect – to investigate the time-course of each effect. By combining these effects, we were able to examine whether spatial codes elicited by target location lead to early divergence in the mouse trajectory, and whether spatial codes elicited by numerical magnitude elicit later divergence in mouse trajectories. In two Experiments, single-digit Arabic numerals were presented in target boxes on either the left or the right of the screen. In Experiment 1, subjects (n = 20) were instructed to ignore the target location and to click on the left or right target box depending on whether a digit was odd or even (parity judgment). In Experiment 2, subjects (n = 20) indicated whether the digit was less than or greater than 5 (magnitude judgment). Mouse trajectories were differentially impacted by Simon and SNARC compatibility, showing that both processes lead to spatial biases, but with different time courses. The precise temporal information provided by mouse tracking may additionally be paired with ERP experiments to identify brain-behavior correlations at a fine-grained temporal scale.

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COULD THE BRAIN WAVES BE TREATED AS BLOCH WAVES? Kanad Ray[1]; [1]Icfai University, India — [4] Brainwaves emanating out of electrical activities by the firing of neurons within the brain could be Bloch waves. The theoretical possibility of dynamic changes in axon propagation is intriguing as it provides an additional layer of computing power to the neuron. A myelinated axon can be modelled as a lossy transmission line of infinite periodic structure and regarded as a cascade of identical cells. Each cell is a two-port composed of a parallel admittance Y and two transmission line segments of length d/2 at each side of the admittance. The admittance of each cell plays the role of Ranvier node and a model will be adopted [1,2,3] where Y = G + j?C. Periodic structures are described by the so called Bloch impedance and could be analyzed in terms of the forward and backward propagating waves that can exist in each unit cell. The Bloch wave which can propagate in the periodic structure is made up from forward and backward propagating normal transmission line or wave guide waves that exist between discontinuities. The transverse electric and magnetic fields of the Bloch wave could be measured by EEG or MEG. 1M.M. Villapecllin et.al. Proc. Of 25th Annual conference, IEEE, EMBS , mexico, sept 17-21, 2003 2..D.R. McNeal, IEEE Trans. Biomed. Eng. Vol. BMI-23, no. 4, P-329-337, 1976 3.M.N. Villapecellin et.al. Proc. iX Med.Conf. Med.Biol.Eng. Comput. IFMBE, Pula, Croatia, 2001 4.Kanad Ray;MathPsych2009(Amsterdam)

I91

PHANTOM LIMB AFTER STROKE: AN UNDERREPORTED PHENOMENON Daniel Antoniello[1], Benzi Kluger, Daniel Sahlein, Kenneth Heilman; [1]Albert Einstein College of Medicine, [2]University of Colorado, [3]New York University Medical Center, [4]University of Florida — The presence of a phantom limb resulting from a cerebral lesion has been reported to be a rare event. No prior study, however, has systematically investigated the prevalence of this syndrome in a group of post-stroke individuals. Fifty post-stroke individuals were examined with a structured interview/ questionnaire to establish the presence and perceptual characteristics of phantom limbs. We document the presence of phantom experiences in over half of these individuals (n = 27). We provide details of these phantom experiences and further characterize these symptoms in terms of temporal qualities, posture, kinesthesia, and associated features. Twenty-two participants reported postural phantoms, which were perceived as illusions of limb position that commonly manifested while lying in bed at night – a time when visual input is removed from multisensory integration. Fourteen participants reported kinesthetic phantoms, with illusory movements ranging from simple single joint sensations to complex goal-directed phantom movements. A striking syndrome of near total volitional control of phantom movements was reported in four participants who had immobile plegic hands. Reduplicative phantom percepts were reported by only one participant. Similarly, phantom pain was present in only one individual - the sole participant with a pre-stroke limb amputation. The results suggest that the perturbation of the body schema after stroke results in phantom experiences more commonly than previously described. We speculate that subtotal deafferance or defective motor efference after stroke may manifest intermittently as a phantom limb.

I92

WINDING AND SPRINGING THE CLOCK Elaine Wencil[1], Matthew Matell[2], H. Branch Coslett[1]; [1]University of Pennsylvania, [2]Villanova University — Recent fMRI investigations have implicated the supplementary motor area (SMA) in supra-second timing. However, it remains unknown whether the SMA plays a primary or supporting role in duration perception. In the current study we selectively enhanced and reduced SMA excitability with transcranial Direct Current Stimulation (tDCS) to determine if modulating SMA firing rates alters the function of the putative "internal clock". Participants performed a Temporal Generalization Task in which a central green circle that varied in duration was presented. Subjects were instructed that one of the durations to be presented had a standard length and their job was to learn that length. Seven durations were presented, the standard (4 seconds) and 6 non-standards spaced around the standard in equal logarithmic steps. To selectively reduce cerebral excitability, 5 participants received cathodal tDCS over FCz; to selectively enhance cerebral excitability 6 participants received anodal tDCS over FCz. Participants performed 72 trials of training prior to tDCS and an additional 72 trials immediately following stimulation. Repeated measure ANOVAs performed on peak amplitude, peak latency, coefficient of variance and variability (r2) revealed tDCS significantly modulated peak latency; cathodal stimulation leads to a 310 msec rightward shift and anodal stimulation leads to a 826 msec leftward shift at testing. These data show that modulating SMA excitability leads to corresponding shifts in clock speed. Altering peak latency and not the coefficient of variance or variability suggests a primary role of SMA in instantiating an internal clock.

I93

RESPONSE INTERFERENCE BETWEEN FUNCTIONAL AND STRUCTURAL ACTIONS LINKED TO THE SAME FAMILIAR OBJECT IS INCREASED IN PATIENTS WITH IDEOMOTOR APRAXIA Steven Jax[1], Laurel Buxbaum[1]; [1]Moss Rehabilitation Research Institute — Viewing objects with the intention to act upon them may activate task-irrelevant motor responses. Many manufactured objects are associated with two classes of actions: grasping in accordance with object structure and skillful use consistent with object function. Further, "conflict" objects, such as calculators, are associated with different actions for structural and functional responses (e.g., clench to grasp, poke to use), whereas "non-conflict" objects, such as drinking glasses, are associated with one action based on both structure and function (clench to grasp and use). We previously demonstrated in healthy participants that use actions were slower in conflict than non-conflict objects (grasp-on-use interference). In the present study we report data from two left hemisphere stroke patients with moderate to severe ideomotor apraxia who exhibited significantly greater grasp-on-use inference than controls and left hemisphere stroke patients with mild ideomotor apraxia. The first patient (with a large periventricular white matter lesion) displayed catastrophic grasp-on-use interference such that she produced grasp-appropriate responses when using conflict objects. The second patient (with a superior parietal and frontal lesion) displayed both grasp-on-use interference as well as an order effect comprising a greater number of use errors with conflict objects when preceded by a block of grasping the same objects (relative to a condition without prior grasping). These data further support the claim that actions to common objects are influenced by competition between multiple responses, and suggest that errors in apraxia may be influenced by deficient resolution of competition between appropriate and inappropriate actions.

I94

EFFECT OF TRANSCRANIAL DIRECT CURRENT STIMULATION IN A MULTISENSORY INTEGRATION TASK Olivia Lapenta[1], Paulo S. Boggio[1]; [1]Mackenzie Presbyterian University — The "motor theory of speech perception" suggests that the objects of speech perception are "phonetic gestures", represented in the brain of the observer as a motor command signal, characterized by phonological articulation. The multisensory structures probably related to that system involve the superior temporal sulcus (STS) and the Broca`s area. These regions have mirror neurons that fire when an individual performs an action, as when he observes a similar action performed by another individual. The aim of this study was to investigate if the stimulation of STS bilaterally interferes by improving or decreasing the performance in a multisensory integration task relating shapes and non-words according to polarity of the stimulation. For that we proposed a Go-NoGo task composed by 10 images, each having a corresponding non-word and presented as congruent or incongruent pairs. Subjects were instructed to press a button when the stimuli were congruent or when it was incongruent depending on the Block. During the task, subjects received anodal, cathodal, or sham transcranial direct current stimulation (tDCS) over the STS. We found an enhancement of correct responses during anodal tDCS as compared with sham and diminishment of correct responses during cathodal tDCS as compared with sham (p=0,02). The effect was independent of gender or stimuli (congruent or not). We showed that tDCS is able to modulate a multisensory integration task in a polarity-dependent manner. In addition, our results shows the critical role of STS in this function. Finally, tDCS appears as an interesting tool in cognitive neuroscience.

I95

EYE BLINK CORRECTION: A TEST ON THE PRESERVATION OF COMMON ERP COMPONENTS Steven Woltering[1], Zhong-Xu Liu[1], Narges Bazargani[2], Marc D. Lewis[1]; [1]University of Toronto, [2]University College London — Introduction: Eye blinks are one of the most pervasive problems in any EEG research as they contaminate the brain signal and can lead to a detrimental loss of trials. To date, the regression-based method is the most widely and conveniently used technique to correct for blinks. It claims to remove the distorting effects of the blink and leave the estimated activity of the brain. However, it's merits are under debate and have mostly been tested using simulated data, and not on common ERP waveforms. Purpose: The current study tests the Gratton method on five different stimulus-locked ERP components (early sensory as well as later processing) and offers a brief literature-review comparing regression-based methods to source-localization and ICA methods. Methods: Dense array EEG from 32 children playing a go-nogo task was used for this study. A within subjects design allowed for multivariate regression modeling predicting 'otherwise rejected' (= corrected) data from 'clean' data containing no blinks. Results: Results, overall, indicate that that the 'corrected' data could be reliably predicted from clean data containing no blinks. This effect was found to be significant ($p < .05$) for most components, except for the later components, like the P300. Conclusion: The Gratton method appears to effectively correct blinks. Caution should be taken when interpreting later components which are more sensitive to distortion. Depending on the research question and time resources, the Gratton method can be a valuable tool compared to other methods.

I96

OROFACIAL REPRESENTATION IN THE PRIMARY SENSORIMOTOR CORTEX: ANATOMICAL AND FUNCTIONAL EVIDENCE Veronika Zlatkina[1], Jurgen Germann[1], Michael Petrides[1]; [1]Montreal Neurological Institute, McGill University — In the primary sensorimotor cortex, there is an orderly arrangement of sensory representations of the different parts of the body along the central sulcus. The postcentral sulcus, which delimits the postcentral gyrus posteriorly, is believed to form the posterior boundary of the primary sensorimotor cortex along its entire length. In the anatomical part of the current study, the postcentral gyrus and postcentral sulcus were examined in serial sections of 40 human MRI brain volumes. In a large number of hemispheres, we observed a sulcus of variable length located anterior to the postcentral sulcus on the postcentral gyrus, namely the transverse postcentral sulcus. The transverse postcentral sulcus has a vertical dorso-ventral orientation and it is often placed in parallel with the postcentral sulcus. In the functional neuroimaging part of the current study, normal human subjects were asked to move different parts of their body in order to find representations of the corresponding bodily regions in the primary sensorimotor cortex. The transverse postcentral sulcus was identified in the MRI brain volumes of several subjects and it formed the posterior boundary of the representations of the upper face, lips and tongue. No functional activation peaks related to representation of the face in the primary sensorimotor cortex were observed posterior to the transverse postcentral sulcus. It is suggested that the transverse postcentral sulcus belongs to the postcentral sulcal complex and it plays an important role as a morphological landmark separating the primary sensorimotor representation of the face from the posterior parietal cortex.

I97

NEURAL CORRELATES OF VIRTUAL REORIENTATION Jennifer Sutton[1,2], Marc Joanisse[2], Nora Newcombe[3]; [1]Brescia University College, [2]The University of Western Ontario, [3]Temple University — The spatial reorientation task, which examines the role of environment shape and visual features when remembering a location, has been used to identify the underlying cognitive mechanisms of navigation in children, adults and a range of animal species. Despite broad interest in the this task across disciplines, little is known about the brain bases of reorientation. We used functional magnetic resonance imaging (fMRI) to examine neural activity in adults during a virtual reality version of the reorientation task. Three environments were used which varied in the cues provided: a rectangular room with four identical gray walls (Geometry), a square room with three gray walls and one red wall (Feature), and a rectangular room with three gray walls and one red wall (Feature + Geometry). While in the scanner, subjects studied the location of a pylon within the room and, after a short break, picked up the pylon from the room's centre and replaced it in the studied location. We conducted two analyses that included a Region of Interest (ROI) analysis focused on structures of the Medial Temporal Lobe (MTL) and an exploratory whole-brain analysis. Multiple areas within MTL, including hippocampus and parahippocampal cortex, showed increased activation when a feature was present compared to when reorientation was based only on geometric cues. In contrast, reliance on geometric cues was associated with significant activation of a number of non-MTL structures including prefrontal cortex and inferior temporal gyrus. These results suggest important differences in the processing of the two types of cue.

I98

A SIMPLE METHOD TO COMMUNICATE WITH A SINGLE CEREBRAL HEMISPHERE Eric Altschuler[1], Ahmed Meleis[1]; [1]New Jersey Medical School — The ability to be able to easily communicate with a single cerebral hemisphere would be of tremendous theoretical (probe the knowledge and skill sets of each hemisphere), practical (performance training and game playing) and clinical (non-invasive pre-surgical testing) value. Currently, to communicate with a single cerebral hemisphere it is necessary to use an invasive procedure—intracarotid administration of sodium amobarbital—study the exceedingly rare commissurotomy patient or use an unwieldy and expensive apparatus with a bite bar and eye tracker. Leung et al. (Vision Sciences Society Annual Meeting 2008 Program page 10) found that when two random dot displays are cycled at 75 Hz individuals observe that the screen appears a uniform grey. However, when one moves one's eyes, saccades, or blinks the screen then appears just the random dot pattern. With someone thus fixating on the center of the screen, stimuli can be shown on the left or right (or further top/bottom left/right) of the screen. Such images in the left (right) visual field will then go to only the right (left) cerebral hemisphere! Information can be obtained back from the right (left) hemisphere by having a person press a button, for example, with the left (right) hand. Individuals can also give verbal responses to displays seen by one cerebral hemisphere. In pilot testing we confirm the known result that there right hemisphere has a deficit in word reading compared with the left hemisphere. We have also played video games such as Pong with one cerebral hemisphere.

I99

A LEABRA-BASED MODEL OF THE INFLUENCES OF THE ANTERIOR CINGULATE CORTEX AND THE AMYGDALA OVER THE DESCENDING MODULATORY PATHWAY OF PAIN PERCEPTION Roberto Limongi[1], Karla Ramirez[1]; [1]Venezuelan Institute for Scientific Research — Pain perception is associated with neural mechanisms that recruit structures from the spinal cord, the rostral ventromedial medulla (RVM), the periaqueductal gray matter (PAG), and cortical areas. fMRI data show the regulatory function of the anterior cingulate cortex (ACC) and the amygdala on pain perception. Animal data have been very informative on the dynamics of the neuronal firing patterns acquired via single-cell recording involving the PAG and the RVM. At a neuronal level, functional connectivity within the PAG-RVM system is modeled via time-varying correlation between two neurons. Top-down influences from the PAG-RVM system to the dorsal horn of the spinal cord seem to be central in the elucidation of analgesia and hyperalgesia. However, a realistic explanation of the nociceptive information processing must include the participation of the ACC and the amygdala over the PAG-RVM system. In this work, we wanted to assess the influence of the ACC and the amygdala over the modulatory effect of the PAG-RVM system on nociceptive information processing in the dorsal horn cells. We present a LEABRA-based model that includes simulated unidirectional activity from the ACC and the amygdala over the PAG-RVM system and its modulatory effect in the dorsal horn. Our model accounts for experimental data simultaneously obtained in the RVM and the dorsal horn of the spinal cord in rats during nociceptive stimulation. Our simulations lead to conclude that activity of the ACC and the amygdala over the PAG-RVM system might contribute to its modulatory effect on the nociceptive processing in the dorsal horn.

I100

COMPRESSED AND LINEAR SCALES OF NUMERICAL REPRESENTATION Arnaud Viarouge[1], Edward Hubbard[1], Bruce McCandliss[1]; [1]Educational Cognitive Neuroscience Lab, Peabody College, Vanderbilt University, Nashville, TN — Non-verbal animals and pre-verbal infants depend on an intuitive, pre-linguistic representation of numerical quantities which becomes less precise with increasing magnitude (a compressed scale). However, literate adults learn that two consecutive numbers are separated by the same distance on a linear scale (e.g., Siegler and Opfer, 2003). We tested whether the compressed representation of numbers was still present in adults by asking participants to indicate whether a random sequence of nine Arabic numerals presented one at a time on a computer screen contained more small or large numbers. A staircase procedure adjusted the proportion of small and large numbers in the series, until it converged on the series of numbers that was judged as most linear for each subject. Participants exhibited a large bias, reporting that a linear series contained too many large numbers, and that a geometric series that actually oversampled small numbers evenly sampled the range – a striking "illusion of compression" (for similar results in the auditory modality, see Banks & Coleman, 1981; Viarouge et al., in press). These results suggest that the more intuitive compressed representation of numbers is still present even in adults who rely on a linear representation of numbers in other contexts. We propose that the linear representation of numbers may depend primarily on linguistic processes, mediated by the left-hemisphere, while the compressed representation of numbers may depend on visuo-spatial processes in the right hemisphere. We are currently testing this hypothesis using a lateralized visual presentation version of our distribution judgment task.

I101

DOMAIN SPECIFIC RESPONSE IN MEDIAL TEMPORAL AND EXTRASTRIATE CORTEX DURING PERCEPTUAL LEARNING OF VISUALLY SIMILAR STIMULI Kim Graham[1], Paul Downing[2], Edward Ingamells[3], Dominic Dwyer[3], Rob Honey[3], Matthew Mundy[1]; [1]Wales Institute of Cognitive Neuroscience, School of Psychology, Cardiff University, [2]Wales Institute of Cognitive Neuroscience, School of Psychology, Bangor University, [3]School of Psychology, Cardiff University — There is increasing evidence that the medial temporal lobe (MTL) processes stimuli in a domain-specific manner, with neuropsychological and fMRI studies highlighting a posterior-anterior dissociation (e.g., posterior hippocampus – scenes, perirhinal cortex and anterior hippocampus – faces/objects). In this event related fMRI experiment, participants made repeated same/different judgements to previously seen and initially novel confusable pairs of faces and complex scenes. Using a series of orthogonal, and independent, functional localisers, clusters of stimulus-selective, novelty-sensitive voxels were identified in two medial temporal regions (perirhinal cortex and posterior hippocampus), and two extrastriate regions (fusiform face area, FFA, and parahippocampal place area, PPA). We asked how activity in these regions was influenced by discrimination accuracy and by trial repetition (e.g., adaptation). In contrast to FFA and PPA, which only cared about preferred category, activity in perirhinal cortex and posterior hippocampus predicted discrimination accuracy for faces and scenes, respectively. Both MTL regions also adapted less rapidly than extrastriate areas over trial repetition, with difference emerging between extrastriate and MTL regions after 8 repetitions. These findings show that domain-specific patterns of responding in the human brain are not just restricted to extrastriate cortex, and highlight a key role for perirhinal cortex and posterior hippocampus, but not FFA and PPA, in storing feature ambiguous representations of faces and scenes, respectively.

I102

ELECTROPHYSIOLOGICAL CORRELATES OF EYEWITNESS IDENTIFICATION Krista B. Friesen[1], James W. Tanaka[1], D. Stephen Lindsay[1]; [1]University of Victoria — We used event-related potentials (ERPS) to investigate the electrophysiology of memory in real-life circumstances such as eyewitness identification. Research using photographs has shown that an ERP component occurring at posterior scalp regions approximately 250 ms after a stimulus is presented (called the N250) is sensitive to manipulations of stimulus familiarity. Other research has shown that a centrally located component called the P300 is associated with the recognition decision. Two experiments were conducted to assess the role of the N250 and P300 in response to a face initially encountered in an in-person encoding episode. In Experiment 1 the participant was introduced to a "culprit" and asked to identify subsequent photos as "yes, culprit" or "not culprit". We found that both the N250 and P300 were larger for the culprit face than for filler faces. While the P300 differentiated culprit from filler immediately, the N250 was significantly different between the two conditions only in the second half of experiment trials. In Experiment 2 the culprit was still among the photos but was not the target. Participants were asked to accuse a different person (the "scapegoat") of being the culprit in order to cover for the "real" culprit. We found that while the N250 and P300 were strongest to the scapegoat face, they also differentiated the culprit from filler faces. The results suggest that these components may index recognition of briefly encountered persons independent of overt responding, providing motivation for the use of real-world encoding events and ERPs to study eyewitness identification accuracy.

I103

FACIAL THERMAL MEASURES OF HEDONIC RESPONSES TO OLFACTORY AND VISUAL STIMULATIONS Sophie Jarlier[1,2,3], Didier Grandjean[1,3], Sylvain Delplanque[1], David Sander[1,4], Klaus R. Scherer[1], Patrik Vuilleumier[1,2]; [1]Swiss Center for Affective Sciences, University of Geneva-CISA, Switzerland, [2]Laboratory for Neurology and Imaging of Cognition, University Medical Center CMU, Geneva, Switzerland, [3]Neuroscience of Emotion and Affective Dynamics Lab, FPSE, University of Geneva, Switzerland, [4]Laboratory for the Study of Emotion Elicitation and Expression, FPSE, University of Geneva, Switzerland — This study used thermal imaging of human facial physiological changes during spontaneous emotions induced by different types of sensory stimuli. Unlike electromyography, non-invasive thermal imaging of the face avoids overloaded equipment and tracks dynamic changes in facial temperature at any distance (>0.4m), with high temporal (<20ms) and thermal (<20mK = <0.02°C) resolutions. Twenty-one volunteers were recorded while they were presented with different kind of olfactory and visual stimuli of different valence (positive vs. negative) as well as neutral stimuli. Breathing was tracked so as to define the onset of inhalation. We found that the corrugator and fronthead areas in the face showed increases in temperature when negative odorants (such as caproic acid or Durian) were presented as compared to neutral or positive ones, but the same regions also showed temperature increases when positive pictures were presented. These thermal modulations therefore appear to be linked to the intrinsic nature of sensory stimulation and to interest and/or attentional modulations triggered by different kind of emotional events, rather than by valence per se. Temporalis and perinasal areas were specifically warmed up when positive odorants (such as floral strawberry or lavender) were presented as compared to neutral ones. In addition, we found that the choice of the control condition (e.g. no odor vs. 'neutral' odor) may also be a crucial factor to interpret thermo-imaging results.

I104

ACTION RECOGNITION DOES NOT RELY UPON MIRROR NEURONS: EVIDENCE FROM LEFT HEMISPHERE STROKE Solene Kalenine[1], Laurel J. Buxbaum[1], H. Branch Coslett[2]; [1]Moss Rehabilitation Research Institute, [2]University of Pennsylvania — Mirror neurons in the inferior frontal gyrus (IFG) and inferior parietal lobule (IPL) are held to be crucial for action recognition, in part because decisions regarding "correctness" of actions are associated with IFG lesions (Pazzaglia et al., 2008). We report data from 43 left hemisphere stroke patients on two action recognition tasks in which they heard and saw an action word ("hammering") and selected from 2 video-clips the one corresponding to the word. In the spatial recognition task, foils contained errors of body posture or movement amplitude/timing. In the semantic recognition task, foils were semantically related (sawing). Participants also performed a control task requiring matching of the same verbs to objects (hammer). Regression analyses controlling for the comprehension task and lesion volume demonstrated that performance on the spatial recognition task was predicted by percent damage to the IPL, while performance on the semantic recognition task was predicted by temporal lesions (Brodmann Areas 20/21 and 36/37). A Voxel-Based Lesion-Symptom Mapping analysis confirmed that poor performance on the spatial and semantic recognition tasks was associated with lesioned voxels in parietal and temporal regions, respectively. The IPL appears critical for disambiguating spatial postures and movements, suggesting a possible role of mirror neuron systems in this circumscribed aspect of gesture recognition. The IFG does not support action recognition in a verb-action matching task.

Perception & Action: Vision

I105

PERCEPTUAL INTERFERENCE AND INTERHEMISPHERIC COLLABORATION Urvi Patel[1], Emma Mehrabi[1], Ryan McGuire[1], Stephanie Ardinger[1]; [1]Christopher Newport University — The present research examined the effects of color-shape congruity on interhemispheric collaboration using Stroop-like fruit and vegetable stimuli (e.g., red apple vs. blue apple). Observers were presented with three stimuli, two located above the point of eye fixation (one to each visual field) and the third located below the point of fixation (to one visual field). Across four different conditions, observers indicated whether the bottom item matched either of the top two items when presented with: (1) black-and-white stimuli, (2) color-shape congruent stimuli, (3) color-shape incongruent stimuli based on shape, and (4) color-shape incongruent stimuli based on color. In order to compare the benefits and costs of distributing information across the two hemispheres, the critical comparison involved trials on which the two matching stimuli project to the same visual field (within-hemisphere) versus trials on which the two matching stimuli project to opposite visual fields (across-hemisphere). Introduction of shape congruent color facilitated matching and led to the best performance, followed by incongruent shape matching, incongruent color matching and finally by black-and-white matching. When presented with shape incongruent color stimuli, color can be ignored during shape matching but shape cannot be ignored during color matching. Despite differences in performance, conditions yielded either a within-hemisphere advantage or no difference between trial types. The results provide further evidence that the benefits of spreading processing across both hemispheres do not necessarily increase as the task becomes more demanding due to perceptual interference.

I106

IDENTIFYING HUMAN BRAIN AREAS ACTIVATED BY ATTENTION TO GLOSSINESS Atsushi Wada[1], Yuichi Sakano[1], Hiroshi Ando[1]; [1]National Institute of Information and Communications Technology, Kyoto, Japan — Surface glossiness is one of the object properties, which can be used as a visual cue for identifying materials of objects in our daily life. Although psychophysical studies of glossiness perception are getting active recently, little is known yet about the neural substrates of the glossiness perception. Here we conducted functional magnetic resonance imaging (fMRI) experiments to analyze the effect of attention to glossiness on the activities in human visual cortex. The stimulus was a computer-generated display which simulated a 3D object defined by three distinct feature dimensions: glossiness, form and orientation. For the glossiness dimension, the surface of the object was set to either glossy or matte. For the form and orientation dimensions, the features were set to one of the two different 3D object forms and one of the two different object orientations, respectively. To let subjects attend selectively to one of the specific visual feature dimensions, they viewed paired objects presented sequentially, and judged whether the designated feature dimension differed or not between the two objects. Each experiment block was assigned to one of the following three conditions: glossiness, form and orientation conditions. In each condition, the corresponding feature dimension was specified just before the start of each block. The results of cortical surface-based group analysis suggest that attention to glossiness activates the ventral occipital areas from the hV4 area to the posterior part of the fusiform gyrus.

I107

TEMPORAL INTEGRATION IN VISUAL WORD RECOGNITION Joachim Forget[1,2], Marco Buiatti[1], Stanislas Dehaene[1]; [1]INSERM, Cognitive Neuroimaging Unit, Neurospin Center, France; University of Paris, Orsay, France; Collège de France, [2]Unit of Neurosurgery, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland — When two displays are presented in close temporal succession at the same location, how does the brain assign them to one versus two conscious percepts? We investigate this issue using a novel reading paradigm in which the odd and even letters of a string are presented alternatively at a variable rate. The results reveal a window of temporal integration during reading, with a nonlinear boundary around approximately 80 msec of presentation duration. Below this limit, the oscillating stimulus is easily fused into a single percept, with all characteristics of normal reading. Above this limit, reading times are severely slowed and suffer from a word-length effect. ERPs indicate that, even at the fastest frequency, the oscillating stimulus elicits synchronous oscillations in posterior visual cortices, while late ERP components sensitive to lexical status vanish above the fusion threshold. Thus, the fusion/segregation dilemma is not resolved by retinal or subcortical filtering, but at cortical level by at most 300 msec. The results argue against theories of visual word recognition and letter binding that rely on temporal synchrony or other fine temporal codes.

I108

STATIC AND DYNAMIC VISUAL PROCESSING IN THE CENTRAL VISUAL FIELD AFTER LEFT OR RIGHT OCCIPITAL LESION Celine Cavezian[1,2,3], Pamela Laliette[1,2], Anne-Claire Viret[1,2,3], Celine Perez[1,2,3], Isabelle Gaudry[1,2,3], Noa Raz[4], Netta Levin[4], Tamir Ben-Hur[4], Olivier Gout[3], Sylvie Chokron[1,2,3]; [1]Laboratoire de Psychologie et Neurocognition, Grenoble, France, [2]ERT TREAT Vision, Fondation Ophtalmologique Rothschild, Paris, France, [3]Service de Neurologie, Fondation Ophtalmologique Rothschild, Paris, France, [4]Hadassah Hebrew University Hospital, Jerusalem, Israel — In homonymous hemianopia (HH), vision quality in the central and ipsilesional visual fields (VF) is still not well-known. In addition, most of studies used static stimuli. To better understand visual processing in hemianopia, we investigated how static or dynamic stimuli were processed in the central VF of hemianopes. In experiment 1, 25 healthy controls, 6 left HH, and 5 right HH had to detect and categorize static natural scene images. In experiment 2, 9 healthy controls, 6 left HH, and 7 right HH (all different from experiment 1) completed a motion detection task and a denomination task of moving objects (Objects From Motion [OFM]: the object form shows up from the opposing movement of groups of black and white dots). Patients performed as well as controls (accuracy) in the scene and the motion detection tasks. Yet, compared to controls, patients were slower in the scene categorization task (controls: 533.76±85.38 msec; right HH: 619.16±82.07 msec; left HH: 661.17±90.45 msec), and had worse performances (accuracy) in the OFM denomination (Percentage of errors: controls = 41.39±18.24; right HH = 71.28±17.92; left HH = 69.31±17.58). Overall, depending on the cognitive demand, vision in the central VF is not intact in hemianopia. When the cognitive demand is low, the occipital lesion did not seem to alter natural scene images and motion processing. However, when the cognitive demand increases, the occipital lesion, either right or left, impaired visual processing in the central (supposed preserved) VF especially for moving stimuli.

I109

THE SACCADIC RE-CENTERING BIAS IS ASSOCIATED WITH ACTIVITY CHANGES IN THE HUMAN SUPERIOR COLLICULUS Ruth Krebs[1,2], Mircea Schoenfeld[2,3], Carsten Boehler[1,3], Allen Song[4], Marty Woldorff[1,5]; [1]Center for Cognitive Neuroscience, Duke University, Durham, NC, [2]Otto-von-Guericke-University, Magdeburg, Germany, [3]Leibniz-Institute for Neurobiology, Magdeburg, Germany, [4]Brain Imaging and Analysis Center, Duke University, Durham, NC, [5]Duke University, Durham, NC — This study investigated neural correlates for the facilitation of saccades towards the primary (or "default") position at the center of straight-ahead gaze. Using an endogenously cued saccade paradigm, we found fMRI activity in a network of saccade-related regions, including areas that exhibited a clear contralateral predominance with respect to saccade direction, namely the SC, IPS, and FEF. In addition to the retinotopic representation of saccade targets within the SC shown previously with single cell recordings, we hypothesized that SC activity would be modulated dependent on the orientation of the saccade vector relative to the primary position, as has been previously shown in animal studies. Such a modulation might reflect that the effort required to move the eyes to the primary position within gaze space is smaller than to other coordinates. The present data support the notion that the SC is sensitive to the orientation of eye movements relative to the primary position, even when saccade direction and amplitude, as well as directional and temporal probabilities, are kept constant. Importantly, saccades in the current paradigm were not reflexively triggered by a peripheral stimulus but rather involved the interpretation of an instructional cue conveying information about saccade direction and timing. Importantly, the cortical eye fields (FEF and IPS) did not show systematic modulation dependent on the saccade direction relative to the primary position. This suggests that the facilitation of re-centering saccades may occur at a later processing stage in the SC following the voluntary target selection in higher cognitive areas.

I110

MAGNO- VERSUS PARVOCELLULAR CONTRIBUTIONS TO EMOTIONAL PERCEPTION Andreas Keil[1], Margaret Bradley[1]; [1]University of Florida — A plethora of studies suggest that affectively arousing stimuli automatically attract attentional resources to facilitate sensory processing. This presentation focuses on time-varying changes of oscillatory electrocortical activity in lower-tier visual cortex as a function of affective salience and structural properties of emotional stimuli. In particular, we manipulated the visual stimulus material to predominantly drive either the magnocellular or the parvocellular portions of the human visual systems, using conditioned stimuli (gabor patches paired/unpaired with electric shock) and pictures depicting emotional scenes. Steady-state visual evoked potentials (ssVEPs) were used as a measure that affords sensitivity to fluctuations of electrocortical activity in lower-tier visual cortex, at near real-time resolution. To evoke ssVEPs, participants viewed 4-second trains of flickering stimuli that were brightness modulated at a rate of 15 Hz. Stimuli were either blurred and shown in grayscale (i.e. magno-preferred), or were red-green highpass filtered/high spatial frequency (i.e. parvo-preferred) exemplars. Results suggest that enhancement of the time-varying ssVEP amplitude is strongest when magno-preferred stimuli have motivational relevance for the observer. Parvo-preferred stimuli showed weak or no modulation in the ssVEP but showed clear modulation of other parameters of emotional responding, such as the late positive potential, which was also extracted from the electrocortical data. This dissociation suggests that lower-tier visual cortical activity is modulated predominantly by magnocellular re-entrant projections that enhance neural activity as a function of emotional relevance for the observer.

I111

FEELING THE PAIN OF THOSE WHO ARE DIFFERENT FROM US: AN EEG/ERP STUDY Anat Perry[1], Shlomo Bentin[1,2], Inbal Ben-Ami Bartal[3], Claus Lamm[3,4], Jean Decety[3]; [1]Hebrew University of Jerusalem, Israel, [2]The Interdisciplinary Center of Neural Computation, Hebrew University of Jerusalem, Israel, [3]University of Chicago, [4]Laboratory for Social and Neural Systems Research University of Zurich, Switzerland — We explored how apparently painful stimuli and the ability to identify with the person on whom the pain is inflicted modulates the putative EEG suppression over sensory-motor cortex in the mu/alpha range (8-12Hz). Analyzing ERPs elicited by the same stimuli we also investigated how early in the perception time-course these factors affect perception. In a 2X2 design, we presented pictures of hands experiencing either needle pricks or being touched by a Q-tip. In the "unlike me" condition the hand was assigned to a patient suffering from a disease in which Q-tips inflicted pain whereas needle pricks did not. In the "like me" condition the hand was assigned to a patient who responded to stimulation in the same way as the participants. Participants were instructed to imagine the feeling of the person whose hand was shown and to evaluate her affective state. Pain conditions elicited greater suppression than non-pain conditions. Moreover, when a stimulus was not painful for the patient but would be painful for the participant (needle prick in the "unlike me" condition), the suppression was significant. When there was no pain involved (Q-tip in the "like me" condition) there was very little suppression. Hence, mu/alpha suppression can be elicited either by observing a potentially painful situation or by empathy for pain, even if the other person is different from oneself. ERP differences between conditions were evident as early as about 140 ms as demonstrated by a modulation of P1 by the same experimental factors.

I112

THE EARLY TIME COURSE OF HUMAN BODY PERCEPTION David Pitcher[1,2], Brad Duchaine[2], Vincent Walsh[2], Nancy Kanwisher[1]; [1]Massachusetts Institute of Technology, [2]University College London — Neuroscientists seeking to understand the cognitive mechanisms that underlie body perception have used functional magnetic resonance imaging (fMRI) to identify spatially distinct category-selective cortical regions in the human brain. One such region, the extrastriate body area (EBA), shows a stronger response to bodies than to other object categories and has been proposed to be the first stage in a cortical network specialized for body perception. To investigate when the EBA processes body information we exploited the temporal precision of transcranial magnetic stimulation (TMS). Ten subjects performed a delayed match to sample body discrimination task while double pulse TMS (separated by 40ms) was delivered at different points from stimulus onset. TMS was delivered over each subjects functionally localised EBA and over a vertex control site. Results show that TMS delivered over EBA disrupted the body discrimination task only when delivered 40 to 80 ms after stimulus onset but in no other time windows up to 240-280 ms. This early disruption of body information suggests when visual body information is first represented in human cortex prior to further processing in higher cortical areas.

I113

REDUCED CONFIGURAL PROCESSING OF OLD FACES IN YOUNG OBSERVERS: EVIDENCE FROM THE N170 FACE INVERSION EFFECT Holger Wiese[1], Stefan R. Schweinberger[1]; [1]Friedrich Schiller University of Jena — Humans are often considered to be face experts, which is assumed to be related to configural processing. Face inversion is believed to severely disrupt configural processing. A neural correlate of this face inversion effect is an enhanced amplitude and latency of the N170 event-related potential component for inverted faces. Because expertise may vary as a function of perceptual experience with a particular class of faces (such as faces of different age groups), we examined whether configural processing for same and other age faces differs in young adult participants. Young and old unfamiliar faces were presented either upright or inverted. To manipulate the availability of age-specifying information (such as detail in skin texture or wrinkles), all faces were presented unfiltered and with three different degrees of low-pass filtering (cut-off frequencies at 30, 20 or 10 cycles per image, cpi). Reaction times in a young-old categorization task were significantly faster for old compared to young faces in all except for the 10 cpi filter conditions. Strong low-pass filtering increased N170 latency and reduced P2 amplitude, but not differentially so for old and young faces. Importantly, the difference in N170 amplitude between upright and inverted faces was significantly smaller for old compared to young faces. This finding suggests decreased configural processing for old compared to young faces, which may be related to a reduced perceptual experience of young adult participants with old faces.

I114

SEARCHING WITH MEMORY Kelly Shen[1], Martin Paré[1]; [1]Queen's University, Kingston, Canada — Current models of selective attention and visual search incorporate two processes believed to be crucial in searching for an item in a visual scene: the selection of locations to be attended and the temporary prevention of re-selecting previously attended locations. In natural situations, the deployment of visual attention is accomplished by sequences of gaze fixations, and the active suppression of recently visited locations can be examined by analyzing the distribution of gaze fixations as a function of time and location. We trained monkeys to perform a visual search task, in which they could freely search for a target stimulus with a unique conjunction of features. Monkeys made multiple fixations on distracters before foveating the target (mean: 3.1; range: 1-14) and their probability of foveating the target with a single fixation was only 0.25. Performance in this difficult task, however, was generally efficient as monkeys rarely re-fixated previously inspected stimuli. The probability of a re-fixation increased with time and approximated chance levels after 5-6 fixations, suggesting that foveated information is retained across fixations but completely degraded within about 1000 ms of fixation. The visual activity of sensory-motor neurons in superior colliculus was sufficient to guide this behavior: activity associated with previously fixated stimuli was significantly lower than that of stimuli not yet fixated. These results suggest a neural mechanism for suppressing the re-fixation of stimuli temporarily maintained in memory. These findings demonstrate how neural representations on the visual salience map are dynamically updated from fixation to fixation, thus facilitating visual search.

I115

WHEN THE FACE AREA RESPONDS TO HOUSES: CODING OF PERCEPTUAL PREDICTION ERROR IN THE VENTRAL VISUAL STREAM Tobias Egner[1], Jim Monti[2], Christopher Summerfield[3]; [1]Duke University, [2]University of Illinois at Urbana-Champaign, [3]University of Oxford — Visual object recognition is traditionally viewed as a passive bottom-up flow of stimulus information along a hierarchy of specialized neuronal feature detectors with increasingly complex response properties. By contrast, 'predictive coding' models posit that each hierarchical level engages in active top-down prediction of inputs from the next lower level, compares predictions against bottom-up signals, and forwards mismatches (prediction error) to the next higher level. A central but controversial tenet of these models is the existence of visual 'prediction error neurons' that complement representational (prediction) neurons at each processing stage. Here, we tested a strong, counterintuitive implication of this proposal, namely, that the feature-specificity in the population response of specialized ventral visual stream areas will vary with expectations: when expecting a preferred stimulus, occurrence of that stimulus should not elicit prediction error, whereas an (unexpected) non-preferred stimulus should. Using functional magnetic resonance imaging (fMRI), we show that neural population responses in the fusiform face area (FFA) to preferred and non-preferred stimuli (faces vs. houses) vary as a function of expectation for faces. Remarkably, and in direct support of predictive coding models, the differential FFA response to face versus house stimuli disappeared under conditions of high face expectation.

I116

ACQUIRED PROSOPAGNOSIA FOLLOWING RIGHT UNILATERAL BRAIN DAMAGE: SPECIFIC AND HOLISTIC PROCESSING IMPAIRMENT OF THE INDIVIDUAL FACE Thomas Busigny[1], Sven Joubert[2], Olivier Felician[3], Mathieu Ceccaldi[3], Bruno Rossion[1]; [1]Universite Catholique de Louvain, Belgium, [2]Universite de Montreal, Canada, [3]AP-HM Timone, Marseille, France — Acquired prosopagnosia – the inability to recognize individual faces despite preserved low-level visual and intellectual abilities – can inform normal face recognition theories. We present the extensive investigation of a new case of prosopagnosia, GG (66 years old), who sustained a stroke to the right posterior cerebral artery, damaging the occipital lobe, lateral fusiform and parahippocampal gyri, unilaterally in the right hemisphere. GG presents a massive prosopagnosia, being unable to recognize from their face both famous and familiar people. Our behavioural testing of GG and age-matched controls aimed at addressing two major issues: (1) can the impairment be restricted to faces; (2) what is the nature of the deficit. First, GG failed all experiments involving face retrograde/anterograde memory and perception. Contrariwise, he was normal at mnesic and perceptual tests with several other object categories (chairs, boats, cars, birds, and famous places). Moreover, he showed normal basic visual integrative processes (Navon effect, 3D figures matching, dots configurations perception). Second, we tested GG with classical paradigms measuring holistic face processing (face inversion effect, composite effect, whole-part advantage). Strikingly, GG did not show any of the three effects. Finally, two face matching experiments showed a reduced sensitivity to the eyes region, and a processing bias to the mouth. Altogether, these observations are in line with different previous studies of prosopagnosia, indicating that lesions to different localizations in the right cortical face network can lead to an inability to extract a holistic representation of the individual face, a fundamental process for normal face recognition.

I117

REVISITING UPRIGHT AND INVERTED FACE RECOGNITION IN 6- TO 12-YEAR-OLD CHILDREN AND ADULTS Adelaide de Heering[1,2], Bruno Rossion[2], Daphne Maurer[1]; [1]McMaster University, Ontario, Canada., [2]Université Catholique de Louvain, Belgium — Adults are experts at recognizing faces. However there is still controversy about how this ability develops with age, with some arguing for adultlike processing by 4-6 years of age (Crookes & McKone, 2009) while others maintaining that this ability undergoes protracted development (Monldoch et al., 2002). Here we tested 108 6- to 12-year-old children and 36 young adults with a digitized version of the Benton Face Recognition Test (Benton et al., 1983), which is known to be a sensitive tool for assessing face recognition abilities (Busigny & Rossion, in press). Participants had to identify 3 faces among 6 alternatives that matched the target face despite changes in viewpoint and lightning. The faces were projected upright and upside-down in separate blocks. Children's correct response times did not improve with age, for either upright or inverted faces, but were significantly slower than those of adults for both conditions. This pattern is consistent with known increases with age in attention and information processing. Accuracy improved between 6 and 12 and significantly more for upright than inverted faces, leading to a larger face inversion effect. Inverted face recognition improved slowly until late childhood whereas the improvement for upright faces was largest before versus after 8 years of age, with a further enhancement by young adulthood. Together the results indicate that during childhood face processing becomes increasingly tuned to upright faces, likely as a result of increasing experience.

I118

ARBITRATING BETWEEN FEEDFORWARD VS. FEEDBACK MODELS OF CONTOUR INTEGRATION IN V1 Marina Shpaner[1,2], Emmajane Forde[1], Sophie Molholm[1,2,3], John J. Foxe[1,2,3]; [1]Nathan Kline Institute for Psychiatric Research, [2]City College of New York, City University of New York, [3]Albert Einstein College of Medicine — Contour integration, the ability to link visual information across space, is an essential element of object and scene perception. It is a mechanism by which the visual system groups simple features at a relatively basic level. The precise neural mechanisms of contour integration remain unclear. Two competing models can explain contour integration effects observable in the primary visual cortex. The first posits that contour integration takes place via long-range horizontal connections within the primary visual cortex: by this account, contours are completed by simultaneous activation of neurons in V1 and enhancement of neural response from neighboring collinear cells. The alternative model posits that downstream collinear V1 neurons converge on "coincidence detectors" in higher order visual areas to achieve initial contour integration. In this scenario, observable V1 effects follow feedback from higher order visual areas. This project investigates the time-course and topography of contour integration in humans using high-density electrophysiology. A feedforward versus a feedback model of contour integration in the primary visual cortex was tested. Stimuli of contours embedded in Gabor noise and stimuli of Gabor noise were presented to sixteen normal volunteers. Analyses revealed no contour-related effects in the earliest evoked component. In contrast, contour integration effects were observed in the later N2 component, localized to the ventral stream visual areas. We conclude that contour integration initially relies on the higher-order ventral stream areas, and that any effects observed in the primary visual cortex follow this initial stage of processing.

I119

SEX HORMONES DIFFERENTIALLY INFLUENCE MENTAL ROTATION AND ROTATED OBJECT RECOGNITION DURING THE MENSTRUAL CYCLE Kevin Wilson[1], Margaret Mintus[1]; [1]Gettysburg College — An important question concerning visual object recognition is whether spatial transformation processes such as mental rotation are used to recognize objects that are rotated into non-upright orientations. Similar viewpoint effects are often observed behaviorally in mental rotation and rotated object recognition tasks (e.g. longer response times as objects are rotated farther from upright), suggesting overlap between the two. This possibility has been challenged, however, by neuroimaging studies showing different patterns of brain activity in each case. While previous neuroimaging studies have partially differentiated the brain areas involved in mental rotation and rotated object recognition, no studies to date have looked at whether both processes are subject to the same sex-steroid influences. More specifically, extensive research suggests that mental rotation performance differs over the course of the menstrual cycle, with better performance during the menstrual (when estradiol and progesterone levels are relatively low) relative to the midluteal phase (when estradiol and progesterone levels are relatively high). It is unknown, however, whether similar effects occur for rotated object recognition. In this study, female participants performed mental rotation and rotated object recognition tasks during the menstrual and midluteal phases of their menstrual cycle. Results showed that menstrual cycle effects on mental rotation (e.g., better performance during the menstrual relative to the midluteal phase) did not correlate with performance changes during rotated object recognition. These findings complement previous neuroimaging studies, and suggest that mental rotation and rotated object recognition not only rely on distinct brain areas, but are also differentially influenced by sex hormones.

I120

VISUAL OBJECT COGNITION PRECEDES AND OVERLAPS WITH MENTAL ROTATION Lisa Lucia[1], Haline Schendan[1]; [1]Tufts University — Event-related potential (ERP) studies have separately indicated that (1) object model selection during cognitive decisions happens during an N3 complex from 200-500 ms, and, (2) as mental rotation increases, parietal negativity (and response time) increases linearly from 400-800 ms. A prior functional magnetic resonance imaging (fMRI) study recorded activity during both visual object categorization and mental rotation in the same participants, and showed overlapping prefrontal-posterior systems during both tasks. This ERP version of the fMRI study assessed whether model selection and mental rotation occur serially or in-parallel. Categorization findings revealed object-sensitive activation before 200 ms (during the P1 and VPP/N170) reflecting figure-ground segregation, and after 200 ms (during the N3 complex) reflecting object model selection. Results from the mental rotation task confirmed linear mental rotation effects on parietal negativity (500-700 ms). In addition, linear effects of mental rotation were discovered on a frontopolar N350 subcomponent of the N3 from 200-700 ms and a centrofrontal N390 subcomponent from 400-500 ms; both were more negative with increasing rotation. Overall, the time course indicates that visual object cognition processes precede (200–500 ms) but also overlap the initial phase of mental rotation (500–700 ms) during parietal negativity. Further, FMRI and ERPs together suggest that linear rotation effects on the frontopolar N350 reflect analysis of the spatial configuration of parts in ventrocaudal intraparietal sulcus for cognitive decisions, whereas those on later parietal negativity reflect mental imagery in superior parietal lobule.

I121

ATTRIBUTION, RECOGNITION AND OBSERVATION OF HUMAN MOVEMENTS: THE ROLE OF THE MIRROR NEURON SYSTEM Luciano Giromini[1], Laura Parolin[1], Jaime A. Pineda[2], Piero Porcelli[3], Donald J. Viglione[4]; [1]University of Milan-Bicocca, Milan, Italy, [2]University of California, San Diego, [3]IRCCS De Bellis Hospital, Castellana Grotte, Italy, [4]Alliant International University, San Diego, California — In 1992 Rizzolatti and colleagues reported on a unique set of neurons that fired both when a macaque performed and when it observed an action. Many studies have investigated whether an analogous system exists in humans. To date the evidence, although indirect, supports the existence of a Mirror Neuron System (MNS) that may play a critical role in imitation learning and the understanding of actions. For the most part, these studies have involved the observation of unambiguous stimuli. The aim of the current study was to examine whether MNS is activated by the observation of ambiguous stimuli, that is, stimuli that could be interpreted as movement without any suggestion by the experimenter. Such an attribution process has been studied within the Rorschach test for almost 100 years with the conclusion that movement attribution is associated with a kinesthetic identification with others, empathy, interest in people, and social competence. To test the hypothesis, a group of 19 students observed Rorschach inkblot stimuli as well as non-ambiguous drawings resembling the inkblots, while their EEG was recorded. Suppression of the 8-13 Hz (Mu) frequency EEG band recorded over sensorimotor cortex (scalp locations C3, Cz and C4) – a presumed index of MNS activity – occurred both for the non-ambiguously drawn human movements and for the Rorschach ambiguous stimuli. This finding provides further support for the connection between MNS and both higher level cognitive skill and also spontaneous activation of movement ideation within individuals.

I122

BEHAVIORAL AND NEUROIMAGING RESPONSES TO FORM-FROM-MOTION STIMULI: A FACTORIAL DESIGN MANIPULATING TWO LEVELS OF LUMINANCE AND MOTION Josh Salmon[1], Heath Matheson[1], Patricia McMullen[1]; [1]Dalhousie University — Object form can be derived visually from many cues including motion and/or luminance differences between foreground and background. When both cues are present in a single form, they must be integrated. Form and motion information is typically processed by the ventral and dorsal visual streams, respectively. The contribution of these two streams to form and motion integration was the focus of this investigation. We first isolated brain regions sensitive to form and motion information using basic localizers. In the experimental task, participants decided whether two visual forms matched. All stimuli (real and non-real objects) were hybrids containing both form-from-motion (FFM) and form-from-luminance (FFL) information, each with two levels. Behavioral results suggest greater sensitivity to differences in luminance compared to differences in motion, especially in the case of real objects. BOLD differences corroborated these findings with the largest BOLD differences between low and high luminance conditions for real objects. For the fMRI data, we considered sites of statistical interaction between motion and luminance as potential integration sites, and we compared the activity of these sites to the areas isolated in the motion and form localizers. Preliminary results suggest that brain regions involved in this task overlapped with areas sensitive to processing form (i.e. LOC) and motion (i.e. MT/V5). Overall, this suggests a contribution of both ventral and dorsal streams.

I124

VISUAL PERSPECTIVE BIASES THE SPEED OF IMITATION-BASED MUSICAL LEARNING Sabrina M. Chang[1], Julia Kam[1], Todd C. Handy[1]; [1]The University of British Columbia — Our research explores the relationship between visual perspective and learning. More specifically, we are interested in seeing whether information presented in first-person perspective versus third-person perspective affects the speed with which a subject will learn a musical concept. Research has shown that third-person representation delays learning but results in better retention due to the increase in effort, encoding, transformation and understanding of the action's spatial configuration. For our first experiment, participants—who had no prior training in piano—watched four short video clips. Each video clip showed a different 3-note chord (triad) being played on a piano keyboard. Each set of videos was shown from either a first-person perspective (looking over the instructor's shoulder) or a third-person perspective (sitting across from the instructor). Upon watching each video clip the participant attempted to learn and recreate the triad on a piano keyboard. The participants then completed a problem-solving exercise that acted as a distracter, after which, he or she was asked to reproduce the triads. The results showed significant perspective effects in that participants spent more time learning chords presented in third-person perspective while the success rate in recall for both groups was the same. In a second, control experiment, we reduced the number of chords to one in order to eliminate possible memory or practice confounds. We found that participants in the third-person condition took longer to learn the chord while the success rate in recall remained the same for both groups.

I125

HOW TO MAKE VISUAL ELECTROPHYSIOLOGICAL DATA A GOOD PREDICTOR OF HUMAN BINOCULAR INTEGRATION? Laura Lefebvre[1,2], Hugo Théoret[1,2], Dave Saint-Amour[1,2,3]; [1]Centre de Recherche, Montréal, Canada, [2]Centre de Recherche en Neuropsychologie et Cognition, Université de Montréal, Canada, [3]Université du Québec à Montréal, Canada — Electrophysiological responses related to binocular interaction in humans are often difficult to interpret because of the lack of direct correspondence with perception. In an attempt to establish an electrophysiological marker of binocular vision, monocular and binocular visual evoked potentials (VEP) were recorded over the occipital cortex (Oz site) in 12 normal young adults (24.7yr ±4.1) for whom interocular differences in refraction (anisometropia), a condition known to disrupt binocular integration, was induced with converging lenses. Reversal checkerboards (2 Hz, 2 cycles/degree, 96% of contrast) were presented monocularly and binocularly according to five dioptre (D) levels: 0, +2, +4, +6 and +8D. Indexes of binocular integration were calculated from the N75-P100 and P100-N150 peak-to-peak amplitude using the following formula: binocular response – the sum of monocular responses. The electrophysiological indexes were then compared with stereoscopic perception as assessed with the Randot Stereo Test. ANOVAs revealed a significant reduction of the binocular integration index under anisometropic viewing, in particular at 4D and more for N75-P100 ($F(4, 40)= 22.95$, $p < .05$) and P100-N150 ($F(2.52, 25.53)= 34.39$, $p < .05$). The same pattern of impairment as a function of interocular differences in refraction was found perceptually, i.e., the stereoperception was abolished at 4D or more. More specifically, the electrophysiological index of binocular integration follows exactly the same function than perceptual integration. This study suggests that appropriate calculation of simple electrophysiological data can constitute a reliable and useful indicator of perception under different conditions of binocular vision.

I126

IDENTIFYING AN EARLIER ONSET OF THE ELECTRICAL BRAIN RESPONSES UNDERLYING PERCEPETUAL COMPLETION OF OBJECTS AND NON-OBJECTS Naddley Desire[1,2], Anthony Hosein[1], Boutheina Jemel[1,3]; [1]Research Laboratory Neuroscience and Cognitive Electrophysiology, Hopital Riviere des Prairies, [2]Universite de Montreal, Canada, [3]Centre de Recherche Fernand Seguin, Universite de Montreal, Canada — Although most viewed objects emerging from our surrounding environment are occluded by one another, perception of their boundaries seldom appear incomplete. This perceptual completion phenomenon illustrates the active properties of underlying neuro-cognitive processes and the dissociation between visual percept and physical stimulus. Findings from some previous event-related potential (ERPs) studies suggest that perceptual completion is indexed by a negative ERP over occipito-temporal scalp sites, known as Ncl. However, given that the Ncl occurs at a relatively late latency (around 290ms), it is possible that it reflects access to object memory representation rather than perceptual processes. Our study addresses this issue by investigating the effect of parametrically fragmented line drawing object and non-object images (scrambled objects) on early and mid-latency electrophysiological responses. ERPs were recorded from 17 participants while they were presented with seven progressively less fragmented images of the same object or non-object (ranging from objectively non-identifiable to a complete image). ERPs were averaged with respect to object and non-object fragmentation levels. We found that while ERP fragmentation level effects started around 200ms (N200) for object and non-object stimuli, N200 amplitude modulations were non-linear for objects and linear for non-objects. As the amount of information is increased, the amplitude of the N200 to non-object stimuli gradually decreased. However, N200 amplitude modulation showed a plateau at fragmentation levels associated with higher object identification rates. Our findings indicate that perceptual closure has an earlier onset than that previously reported and that different neuro-cognitive processes underlie perceptual completion of objects and non-objects.

I127

ELECTROPHYSIOLOGICAL STUDY OF CENTRAL AND PERIPHERAL VISUAL FIELDS: VALIDATION OF A METHOD Noémie Hébert[1,2], Maryse Lassonde[1,2], Dave Saint-Amour[1,2]; [1]Montreal University (CERNEC), [2]CHU Sainte-Justine Research Center — Introduction: The study of the integrity of the central and peripheral fields seems to be an issue when it comes to pediatric populations touched by differential visual field impairment. The perimetry, used to discriminate the different region's integrity, is rarely reliable in childhood. Moreover, the ERG and PEV data rarely distinguish both visual fields. Therefore, the study's goal is to validate a quick and non-biased way of measuring a patient's visual fields integrity. Method: We have developed a steady-state VEP paradigm that allows simultaneous discrimination of both central and peripheral fields. Similar to Harding et al. (2002), the stimulus consisted of two radial checkerboards in which the central stimulation (0-5° radius) flickered at 15 reversals/s and the peripheral stimulation (30-60° radius) oscillated at 12 reversals/s. PERGs and VEPss were recorded from surface electrodes to estimate the integrity of the ganglion cells and the visual cortex, respectively. Central and peripheral responses were extracted with a Fourier analysis. In this study, a group of healthy adults, a group of healthy children and a clinical group of children with either a central or a peripheral field of vision deficit were tested. Results: The results from PERGs and VEPss show that both healthy groups have a normal vision. However, deficits were found in the clinical group that are coherent with the diagnostic given to each patient. Conclusion: Our method is rapid, objective and covers a large visual field. It appears promising to study the integrity of visual fields in different type of clinical populations.

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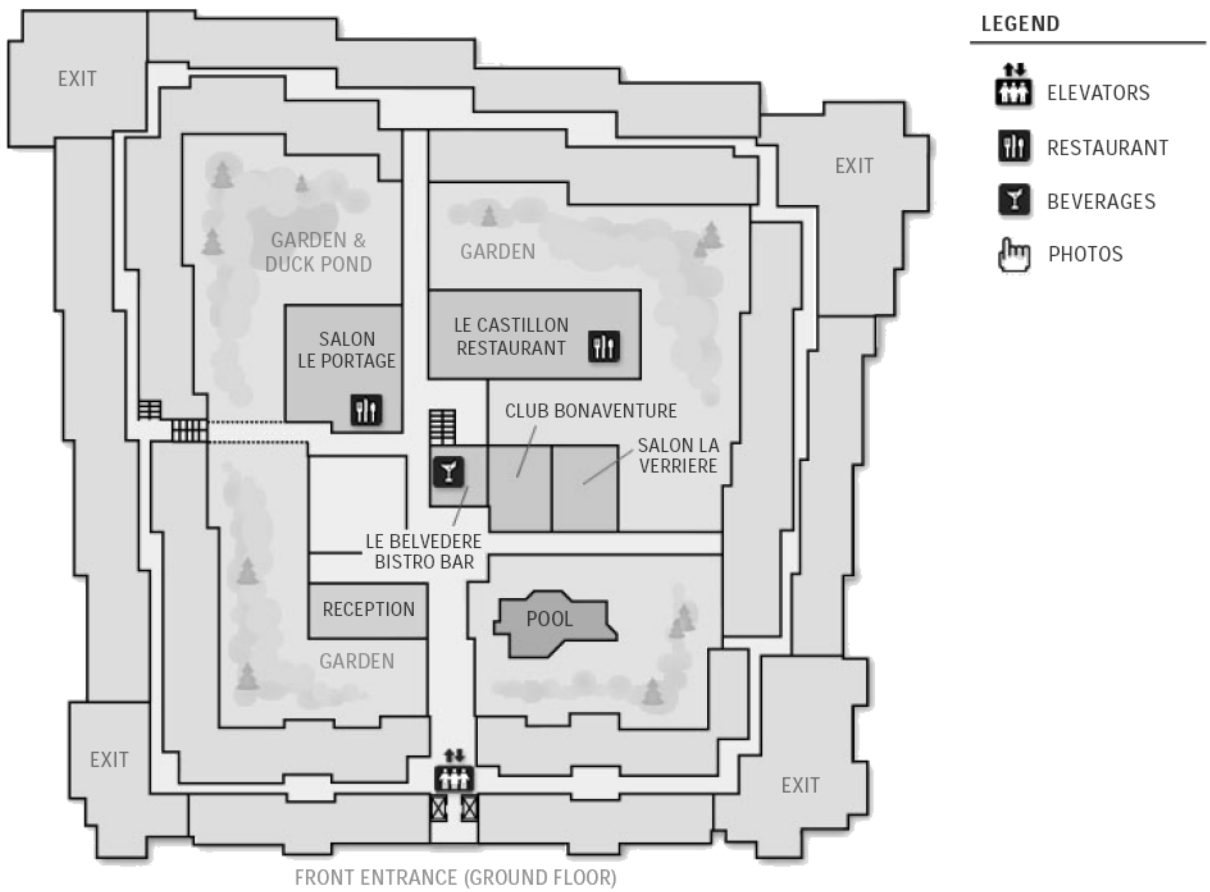
floor plans

LOBBY LEVEL


LEGEND
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RESTAURANT
BEVERAGES
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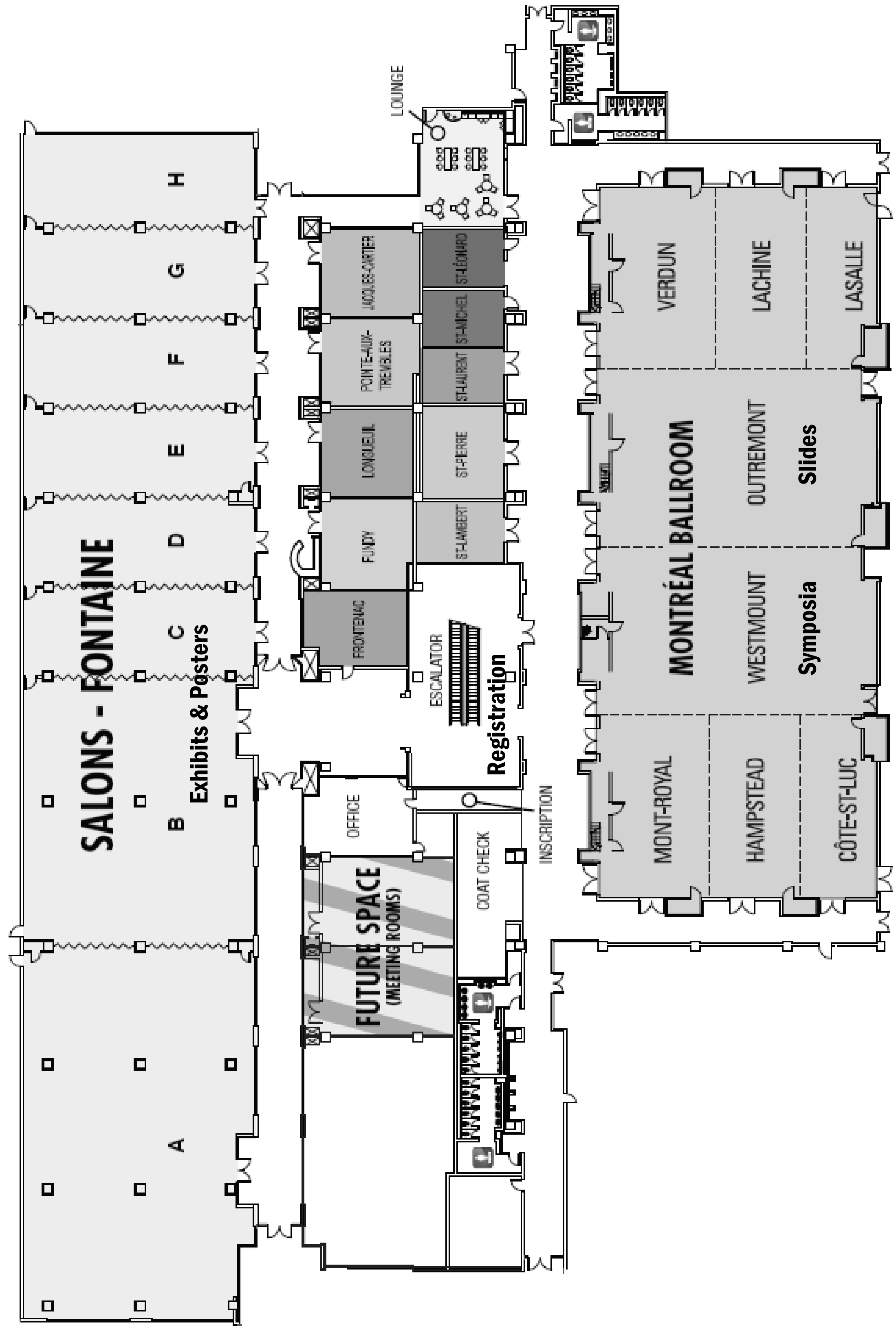
GARDEN & DUCK POND
GARDEN
SALON LE PORTAGE
LE CASTILLON RESTAURANT
CLUB BONAVENTURE
SALON LA VERRIERE
LE BELVEDERE BISTRO BAR
RECEPTION
POOL
GARDEN
FRONT ENTRANCE (GROUND FLOOR)


SALONS - FONTAINE
Exhibits & Posters
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JACQUES-CARTIER
ST-LAMBERT
ST-PIERRE
ST-LAURENT
ST-MICHEL
ST-LÉONARD
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VERDUN
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OUTREMONT
Slides
WESTMOUNT
Symposia
MONT-ROYAL
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