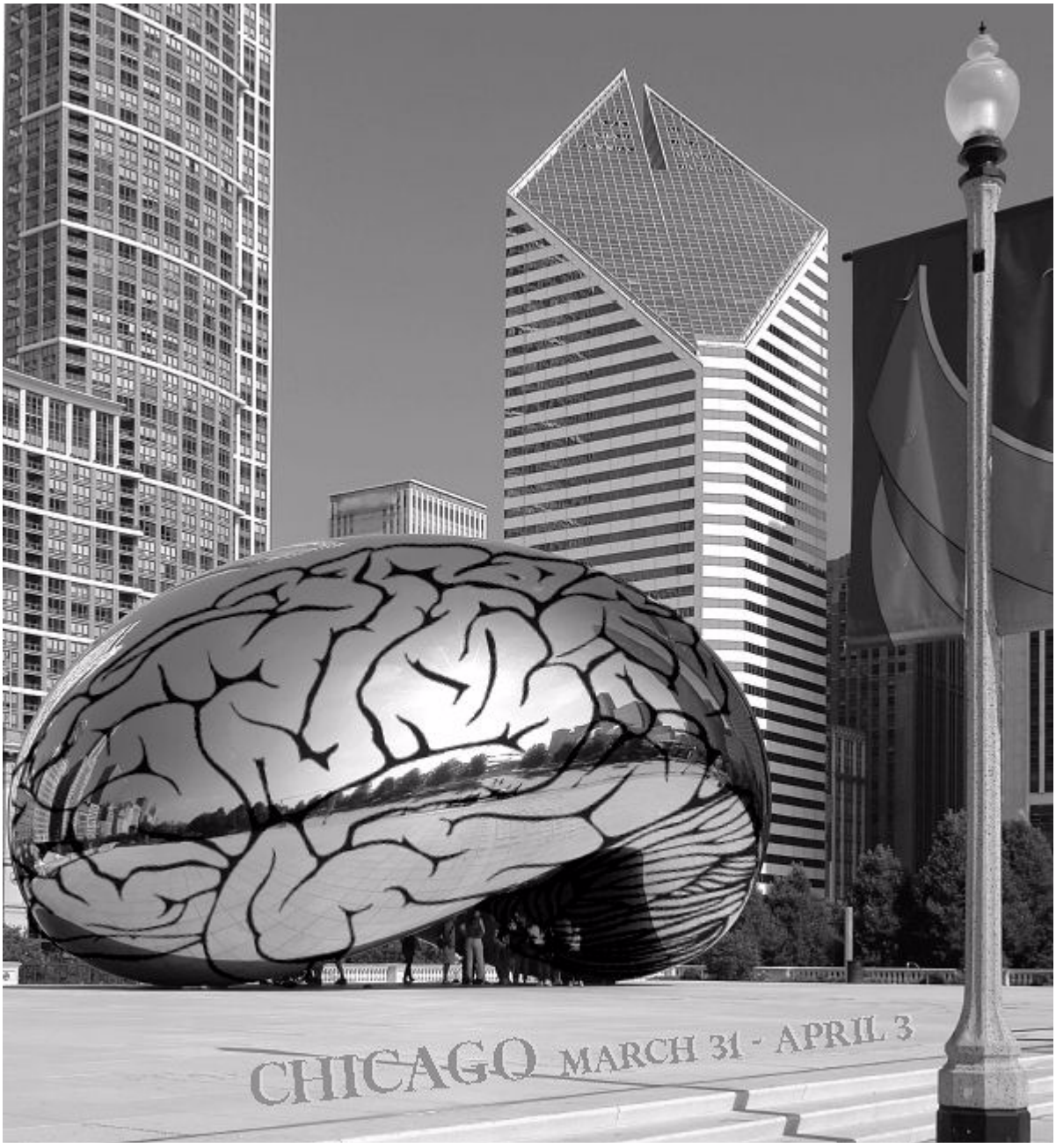
Cognitive Neuroscience Society
2012 Annual Meeting Program



A Supplement of the Journal of Cognitive Neuroscience

Cognitive Neuroscience Society, c/o Center for Mind and Brain
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Table of Contents

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The CNS Program Committee reserves the right to change the meeting program at any time without notice.
This program was correct at the time of print.

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Schedule Overview

Saturday, March 31, 2012

12:00 - 5:00 pm	Exhibitor Check-In, *Exhibit Hall*
12:00 - 7:00 pm	Onsite & Pre-Paid Registration Check-In, *Grand Ballroom Foyer*
1:00 - 3:00 pm	Slide Session 1, "Attention and Executive Functions," *Grand Ballroom*
3:00 - 4:15 pm	Slide Session 2, "Open Paper Session," *Grand Ballroom*
4:30 - 5:30 pm	18th Annual George A. Miller Prize in Cognitive Neuroscience, *Grand Ballroom*
	Announcement of the Young Investigator Awards, *Grand Ballroom*
5:30 - 6:30 pm	GAM and Welcome Reception, *Exhibit Hall*
5:30 - 7:30 pm	Exhibit Hall Open, *Exhibit Hall*
5:30 - 7:30 pm	Poster Session A, *Exhibit Hall*

Sunday, April 1, 2012

7:30 am - 6:00 pm	Onsite & Pre-Paid Registration Check-In, *Grand Ballroom Foyer*
8:00 - 10:00 am	Exhibit Hall Open, *Exhibit Hall*
8:00 - 8:30 am	Continental Breakfast, *Exhibit Hall*
8:00 - 10:00 am	Poster Session B, *Exhibit Hall*
10:00 am - 12:00 pm	Symposium Session 1, "Emotion's Impact on Cognition – Dissociating Enhancing and Impairing Effects," *Grand Ballroom*
	Slide Session 3, "Perception," *Red Lacquer Room*
12:00 - 1:00 pm	Lunch Break
1:00 - 3:00 pm	Exhibit Hall Open, *Exhibit Hall*
1:00 - 3:00 pm	Poster Session C, *Exhibit Hall*
2:30 - 3:00 pm	Coffee Service, *Exhibit Hall*
3:00 - 4:00 pm	Distinguished Career Contributions Award in Cognitive Neuroscience, *Grand Ballroom*
4:00 - 5:00 pm	DCC Reception, *Exhibit Hall*
4:00 - 6:00 pm	Exhibit Hall Open, *Exhibit Hall*
4:00 - 6:00 pm	Poster Session D, *Exhibit Hall*

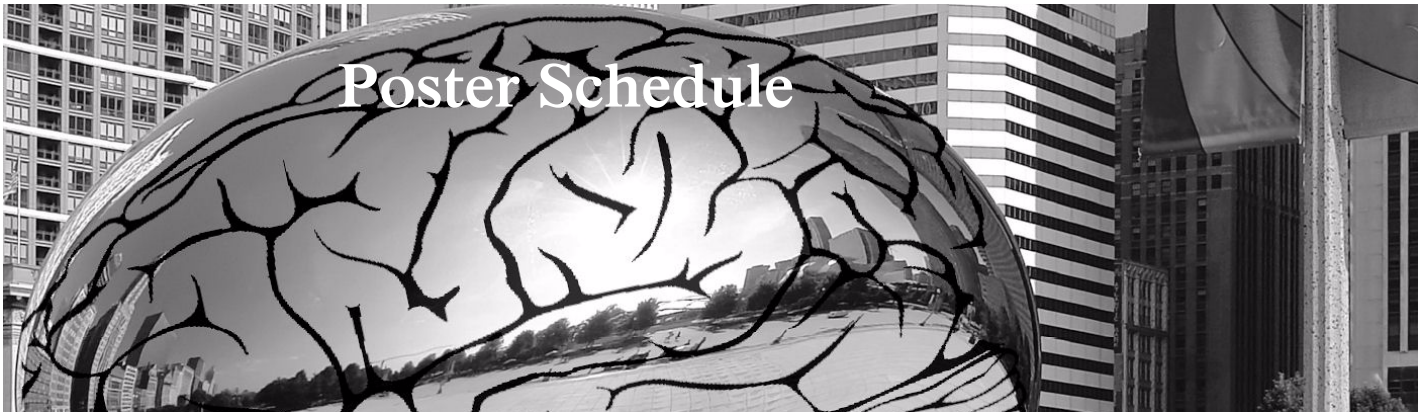
Monday, April 2, 2012

8:00 am - 7:00 pm	Onsite & Pre-Paid Registration Check-In, *Grand Ballroom Foyer*
8:00 - 10:00 am	Exhibit Hall Open, *Exhibit Hall*
8:00 - 8:30 am	Continental Breakfast, *Exhibit Hall*
8:00 - 10:00 am	Poster Session E, *Exhibit Hall*
9:00 - 9:40 am	YIA Special Lecture 1 - Adam Aron, *Grand Ballroom*
10:00 am - 12:00 pm	Symposium Session 2, "Using Non-Invasive Brain Stimulation to Enhance Cognitive and Motor Abilities in the Typical, Atypical, and Aging Brain," *Grand Ballroom*
	Slide Session 4, "Thinking and Decision Making," *Red Lacquer Room*
12:00 - 1:00 pm	Lunch Break
1:00 - 3:00 pm	Exhibit Hall Open, *Exhibit Hall*
1:00 - 3:00 pm	Poster Session F, *Exhibit Hall*
2:30 - 3:00 pm	Coffee Service, *Exhibit Hall*

3:00 - 5:00 pm Symposium Session 3, "Music as a Medium for Perception and Action," *Grand Ballroom*
Slide Session 5, "Language," *Red Lacquer Room*
5:00 - 7:00 pm Exhibit Hall Open, *Exhibit Hall*
5:00 - 7:00 pm Poster Session G, *Exhibit Hall*

Tuesday, April 3, 2012

8:00 am - 5:00 pm Onsite & Pre-Paid Registration Check-In, *Grand Ballroom Foyer*
8:00 - 10:00 am Exhibit Hall Open, *Exhibit Hall*
8:00 - 8:30 am Continental Breakfast, *Exhibit Hall*
8:00 - 10:00 am Poster Session H, *Exhibit Hall*
10:00 am - 12:00 pm Symposium Session 4, "The Brain on Food: Investigations of motivation, dopamine and eating behaviors," *Grand Ballroom*
Slide Session 6, "Long-Term Memory," *Red Lacquer Room*
12:00 - 1:00 pm Lunch Break
1:00 - 3:00 pm Symposium Session 5, "Understanding events: New cross-disciplinary research," *Grand Ballroom*
Slide Session 7, "Emotion and Social," *Red Lacquer Room*
3:00 - 5:00 pm Exhibit Hall Open, *Exhibit Hall*
3:00 - 3:30 pm Coffee Service, *Exhibit Hall*
3:00 - 5:00 pm Poster Session I, *Exhibit Hall*



Poster Schedule

Poster sessions are scheduled for Saturday - Tuesday in the 4th floor Exhibit hall of the Palmer House Hotel. All attendees must present their CNS 2012 name badge to enter the exhibit hall. Do not leave personal items in the poster room.

The presenting author must be present during the assigned session. You may post your materials on the board assigned to you at any time after the "Set-up Begins" time (listed below), but before the beginning of the assigned poster session. You must remove your poster promptly no later than the time listed above in "Take-down Complete." Any posters left up after the "Take-down Complete" time may be discarded.

Only badged poster presenters for the current session and exhibitors will be allowed in the exhibit hall during set up and take-down hours. All other attendees will be turned away at the door.

No attendee or exhibitor will be allowed to enter the exhibit hall after the Closed for the Day - No Entry hours.

Exhibit Hours - Open to all Attendees

Saturday	5:30 - 7:30 pm
Sunday	8:00 - 10:00 am 1:00 - 3:00 pm 4:00 - 6:00 pm
Monday	8:00 - 10:00 am 1:00 - 3:00 pm 5:00 - 7:00 pm
Tuesday	8:00 - 10:00 am 3:00 - 5:00 pm

Exhibit Hall Closed for the Day - No Entry

Saturday	7:45 pm
Sunday	6:15 pm
Monday	7:15 pm
Tuesday	5:15 pm

Poster Session	Date & Time	Set-up Starts	Session Begins	Session Ends	Take-down Ends	Keywords Included
A	Saturday, March 31	5:00 pm	5:30 pm	7:30 pm	7:45 pm	Attention, Emotion & Social, Executive P rocesses, Language, Long-Term Memory, Neuroanatomy, Other, Perception & Action, Thinking
B	Sunday, April 1	*7:30 am	8:00 am	10:00 am	10:30 am	Attention, Emotion & Social, Executive Processes, Language, Long-Term Memory, Perception & Action, Thinking
C	Sunday, April 1	12:30 pm	1:00 pm	3:00 pm	3:30 pm	Attention, Emotion & Social, Executive Pro-cesses, Language, Long-Term Memory, Thinking
D	Sunday, April 1	3:30 pm	4:00 pm	6:00 pm	6:15 pm	Attention, Emotion & Social, Executive Processes, Language, Long-Term Memory, Methods, Perception & Action, Thinking
E	Monday, April 2	*7:30 am	8:00 am	10:00 am	10:30 am	Attention, Emotion & Social, Language, Long-Term Memory, Methods, Perception & Action, Thinking

Poster Session	Date & Time	Set-up Starts	Session Begins	Session Ends	Take-down Ends	Keywords Included
F	Monday, April 2	12:30 pm	1:00 pm	3:00 pm	3:30 pm	Attention, Emotion & Social, Executive Processes, Language, Long-Term Memory, Perception & Action, Thinking
G	Monday, April 2	4:30 pm	5:00 pm	7:00 pm	7:15 pm	Attention, Emotion & Social, Executive Processes, Language, Long-Term Memory, Perception & Action, Thinking
H	Tuesday, April 3	* 7:30 am	8:00 am	10:00 am	10:30 am	Emotion & Social, Executive Processes, Language, Long-Term Memory, Perception & Action
I	Tuesday, April 3	2:30 pm	3:00 pm	5:00 pm	5:15 pm	Emotion & Social, Executive Processes, Language, Long-Term Memory, Methods, Perception & Action

* Please note that only scheduled poster presenters may enter the exhibit hall during the early morning set-up time. All other attendees may only enter when the exhibit hall opens at 8:00 am.

Student Association Social Night

Monday, April 2, 7:00 pm, Palmer House Hilton Hotel Lounge and Cactus Bar & Grill

All students of the Cognitive Neuroscience Society are welcome. We will introduce everyone to each other and get acquainted before we head out around 7:30 pm to Cactus Bar & Grill (404 South Wells St., at Wells and Van Buren)

There is no cover charge at the bar. Attendees are responsible for purchasing their own food and drinks (sorry, no funding :)) More information can be found on the Cognitive Neuroscience Society Student Association Facebook page (http://www.facebook.com/CNSStudentAssociation).

We look forward to meeting you!

Graduate Student Award and Postdoctoral Fellows Award

Graduate Student Award

Six to ten abstracts are chosen each year to receive the Graduate Student (GSA) award. Winners are awarded a $500 travel award and identified as GSA winners in the meeting program. GSA was previously named Graduate Students Present (GSP).

GSA presentations are specially-recognized slide presentations that are scheduled and presented with the topically organized slide sessions. As with standard slide presentations, each GSA student first author is given 15 minutes to present and discuss his or her research findings. GSA applications that were not chosen were automatically considered for a standard slide or poster presentation.

2012 GSA Award Recipients

Congratulations to the following winners of the 2012 GSA Award.

Julian Keil, University of Konstanz
Single trial pre-stimulus beta-band phase influences audiovisual integration
Category: Perception

Eva Telzer, UCLA
The Effects of Inadequate Sleep on Brain Function During Risk Taking in Adolescence
Category: Thinking and Decision Making

Christopher T. Smith, University of North Carolina at Chapel Hill
Interacting effects of genetic polymorphisms regulating dopamine signaling in the frontal cortex on accurate target detection under high working memory load
Category: Attention and Executive Functions

Zhenghan Qi, University of Illinois, Urbana-Champaign
Neurocognitive plasticity in verb bias learning: An ERP study
Category: Language

Vishnu Murty, Duke University
Reward Motivation Increases Hippocampal Sensitivity to and Memory for Expectancy Violations
Category: Long-Term Memory

Helen Weng, University of Wisconsin-Madison
Multi-Voxel Pattern Analysis of Brain States After Compassion Training Predicts Charitable Donations
Category: Emotion and Social

Postdoctoral Fellows Award

We are excited to announce the addition of the new Postdoctoral Fellows Awards (PFA) in 2012! The award will recognize outstanding contributions by CNS members during their postdoctoral careers. Up to seven awardees will be selected from among eligible submissions for slide presentations for the annual meeting. Awardees receive a $500 travel award and are identified as recipients in the meeting program.

The presentations by the Postdoctoral Fellows Award recipients are specially-recognized slide presentations that are scheduled and presented with the topically organized slide sessions. One winner presents in each of the slide sessions. As with standard slide presentations, each first author is given 15 minutes to present and discuss their research findings.

Applicants who were not selected for an award were still considered for a standard slide or poster presentation.

2012 PFA Award Recipients

Congratulations to the following winners of the 2012 PFA Award.

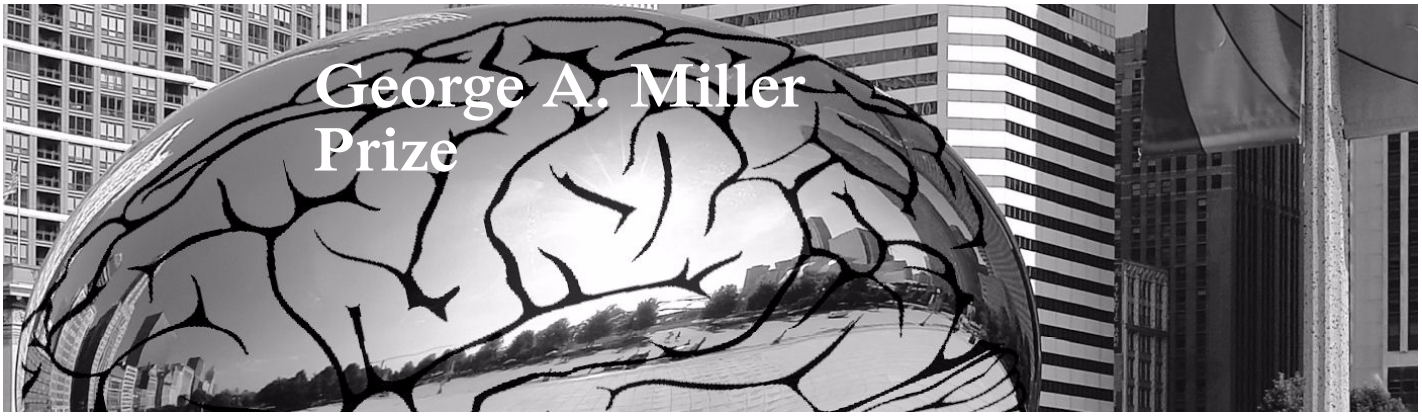
Leonardo Fernandino, Medical College of Wisconsin
Where is the action? Action sentence processing in Parkinson's disease
Category: Language

Jascha Swisher, Vanderbilt University
Variability in simple reaction times correlates with BOLD onset latency in motor cortex
Category: Perception

Jamil Zaki, Harvard University
Equitable decision-making is associated with neural markers of value
Category: Emotion and Social

Ilana Dew, Duke University
Creating illusory memories with masked priming
Category: Long-Term Memory

Gregory Samanez-Larkin, Vanderbilt University
A thalamocorticostriatal dopamine circuit for psychostimulant-enhanced human cognitive flexibility
Category: Attention and Executive Functions



18th Annual George A. Miller Prize in Cognitive Neuroscience

Saturday, March 31, 4:30 - 5:30 pm, Grand Ballroom
Reception to follow, 5:30- 6:30 pm, Exhibit Hall

The Cognitive Neuroscience Society is pleased to announce the recipient of the 2012 George A. Miller Prize in Cognitive Neuroscience.

Dr. Eve Marder
Brandeis University

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.

Beyond the Mean to the Individual: Understanding Neuronal and Network Activity

Ion channels, receptors, and other membrane proteins are constantly being replaced on time scales from minutes to hours to days. At the same time, circuit function must remain stable over years and decades. Computational and experimental studies suggest that a series of homeostatic mechanisms preserve circuit stability despite the turnover of circuit components. Additionally, recent theoretical and experimental work shows that similar circuit outputs can be produced with highly variable circuit parameters. This suggests that the nervous system of each healthy individual has found a set of different solutions that give "good enough" circuit performance. Studies using the rhythmic central pattern generating networks in the crustacean stomatogastric nervous system argue that synaptic and intrinsic currents can vary far more than the output of the circuit in which they are found. As a corollary, to understand circuit performance, merely collecting mean data from many individuals can lead to errors. Instead, it becomes important to measure as many individual network parameters in each individual as possible. These data have implications for the kinds of changes that allow the nervous system to recover function after injury.

About Eve Marder

Eve Marder is the Victor and Gwendolyn Beinfield Professor of Neuroscience in the Biology Department of Brandeis University and is the Head of the Division of Science at Brandeis. Marder received her Ph.D. in 1974 from UCSD, and subsequently conducted a one-year postdoc at the University of Oregon and then a 3 year postdoc at the Ecole Normale Superieure in Paris, France. She became an assistant professor in the Biology Department at Brandeis University in 1978, received tenure in 1984, and was promoted to professor in 1990. During her time at Brandeis University Professor Marder was instrumental in the establishment of the undergraduate and Ph.D. programs in Neuroscience.

Marder was Chief Editor of the Journal of Neurophysiology from 2002-2008. She has served on the editorial boards of Physiological Reviews, Journal of Neurobiology, Journal of Neuroscience, Journal of Comparative Neurology, Current Biology, Current Opinion in Neurobiology, Journal of Experimental Biology, Journal of Comparative Physiology, and PNAS. Marder has served on numerous study sections and review panels for the NIH, NSF, and other funding agencies, as well as on advisory boards of numerous institutions, including Janelia Farms, NCBS (Bangalore), and the McGovern Institute at MIT.

Marder was President of the Society for Neuroscience in 2008. Prior to this she served on the Council for the Society for Neuroscience, Council of the Biophysical Society and several APS committees. She is now a member of the NINDS Council.

Marder is a member of the National Academy of Sciences, a member of the American Academy of Arts and Sciences, a Fellow of the Biophysical Society and a Fellow of the American Association for the Advancement of Science. She received the Miriam Salpeter Memorial Award for Women in Neuroscience, and the W.F. Gerard Prize from the Society for Neuroscience, and an Honorary Doctor of Science from Bowdoin College. She has received two NINDS Javits Awards and a Merit Award from NIMH.

Marder studies the dynamics of small neuronal networks using the crustacean stomatogastric nervous system. Her work was instrumental in demonstrating that neuronal circuits are not "hard-wired" but can be reconfigured by neuromodulatory neurons and substances to produce a variety of outputs. Together with Larry Abbott, her laboratory pioneered the "dynamic clamp". Marder was one of the first experimentalists to forge long-standing collaborations with theorists and has for more than 20 years combined experimental work with insights from modeling and theoretical studies. Starting in the early 1990's, her lab pioneered studies of homeostatic regulation of intrinsic membrane properties, which was instrumental in stimulating work on the mechanisms by which brains remain stable while allowing for change during development and learning. This work addressed issues relevant to understanding how stability in networks arises despite ongoing channel and receptor turnover and modulation. Most recently, she is studying the extent to which similar network performance can arise from different sets of underlying network parameters. In this way it opens a detailed study of the variation in individual brains in normal healthy animals.

Distinguished Career Contributions Award

Sunday, April 1, 3:00 - 4:00 pm, Grand Ballroom
Reception to follow, 4:00 - 5:00 pm, Exhibit Hall

The Cognitive Neuroscience Society is pleased to announce the recipient of the inaugural Distinguished Career Contributions Award.

Dr. Morris Moscovitch
University of Toronto and the Rotman Research Institute of Baycrest Centre for Geriatric Care

The Distinguished Career Contributions (DCC) award honors senior cognitive neuroscientists for their distinguished career, leadership and mentoring in the field of cognitive neuroscience. This year's recipient was selected by a subcommittee of the CNS Governing Board from among the nominations received in response to the George A. Miller Prize call.

Episodic memory and hippocampal-neocortical interactions:

How are memory and knowledge acquired, retained and applied? In the last 20 years, long-held views about the neural substrates mediating recent and remote episodic and semantic memory have been modified by some surprising, yet converging, evidence from psychology and from cognitive and behavioural neuroscience. These findings shed a new light on the function of the hippocampus and neocortex in memory, and opened new fields of investigation on the influence of episodic memory in other domains including perception, language, imagination, problem solving, and decision making.

About Morris Moscovitch

Morris Moscovitch, is Professor of Psychology at the University of Toronto and staff scientist at the Rotman Research Institute, and holds the Glassman Chair in Neuropsychology and Aging. Born in Bucharest, Roumania in 1945, he moved to Israel at four and to Canada at seven. He received his B.Sc. at McGill in 1966 with Peter Milner, and his MA and PhD from the University of Pennsylvania in 1972 with Paul Rozin, followed by a post-doctoral fellowship at the Montreal Neurological Institute with Brenda Milner (1973-74). He has been a visiting professor at the Hebrew University with Shlomo Bentin (1978-79, and 2000), at The Institute of Advanced Studies in Jerusalem, with Israel Nachshon (1985-86), and at The University of Arizona, with Lynn Nadel (1996, 1999-2000). He was elected a Fellow of Divisions 3 and 6 of APA, of AAAS, of The Royal Society of Canada, and the Society for Experimental Psychology, and was the recipient, in 2008, of the Hebb Award from CSCBBCS (Canada). Dr. Moscovitch also received the William James Award, from APS, and in 2012, the Distinguished Career Contribution Award from CNS. He was Co-Editor-in-Chief and Section Editor of Neuropsychologia and serves on the editorial board of many other journals. His research interests include memory, face-recognition, attention, and hemispheric specialization in young and old adults and in people with focal lesions and degenerative disorders. He is married to Jill Ornstein and they have two children, and three grandchildren.

Young Investigator Award

The Young Investigator Award in Cognitive Neuroscience recognizes outstanding contributions by scientists early in their careers. Two awardees, one male and one female, are named each year and are honored at the annual meeting (immediately before the George A. Miller Award). Each winner received a $500 award and gives a 30-minute talk at the meeting.

The Cognitive Neuroscience Society is pleased to present this year's recipients of the Young Investigator Award.

Brain circuits for controlling response tendencies

Adam Aron, Ph.D., Associate Professor, Dept of Psychology, University of California San Diego

Monday, April 2, 9:00 - 9:40 am, Grand Ballroom

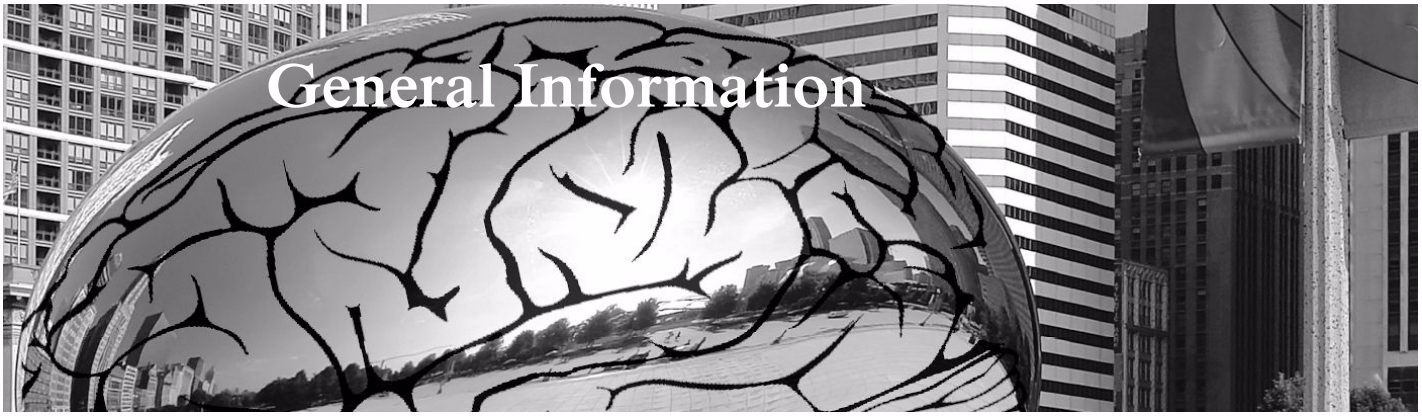
The ability to control inappropriate response tendencies is a key feature of human self-control. Such control requires integrating goals about what tendencies to stop with inhibitory control mechanisms that target the motor system. I will present evidence about the neural correlates in humans using several neuroscience methods including imaging, stimulation and electrophysiology. I will argue that the control of inappropriate response tendencies is implemented via prefrontal cortex in concert with the basal ganglia and I will outline several theoretical and clinical implications.

Adam R. Aron is an Associate Professor in the Department of Psychology at the University of California, San Diego. He received his PhD in cognitive neuroscience from the University of Cambridge in 2003, and was subsequently a postdoc at UCLA. His overarching concern is to better understand how people control themselves, especially how they stop, or prepare to stop, inappropriate response tendencies. To understand the brain architecture underlying such cognitive control he performs studies with electrophysiology, magnetic resonance imaging, Transcranial Magnetic Stimulation and patient groups. His research has been supported by the National Institutes of Health (NIDA), the National Science Foundation, NARSAD, CHDI and the Alfred P. Sloan foundation.

Roshan Cools, Ph.D., Donders Institute for Brain, Cognition and Behaviour, Centre for Cognitive Neuroimaging, Radboud University Nijmegen Medical Centre, Department of Psychiatry

Roshan Cools is currently on maternity leave and is unable to attend CNS 2012. She will present her YIA lecture at CNS 2013 in San Francisco.

Roshan Cools is Full Professor of Cognitive Neuropsychiatry at the Radboud University Nijmegen Medical Centre and the Donders Institute for Brain, Cognition and Behaviour, where she directs the Cognitive Control group. She received her MPhil (1999) and PhD (2003) in Experimental Psychology at the University of Cambridge, UK. After her PhD she received a Royal Society Dorothy Hodgkin (2002) and a Royal Society University Research Fellowship (2006). From 2003 until 2005, she conducted postdoctoral work at the Helen Wills Neuroscience Institute at UC Berkeley, California. Her group combines psychopharmacology with experimental psychology, functional and chemical neuroimaging, patient work, genetics and transcranial magnetic stimulation to address mechanistic questions about neural, neurochemical and psychological processes of the cognitive and motivational control of decision making. In particular her group aims to advance our understanding of the system-level mechanisms by which the ascending neuromodulators dopamine and serotonin affect behavioural control in humans, with the ultimate aim to contribute to both basic cognitive neuroscience and cognitive neuropsychiatry.



General Information

Abstracts

The poster and slide abstracts can be found in the printed program and in the PDF version which is downloadable from the cnsmeeting.org website.

ATM

Three permanent ATMs are located in the Palmer House Hilton Hotel, two on street level and one in the lobby.

Audiovisual Equipment for Talks

LCD projectors (e.g., for PowerPoint presentations) will be provided in all rooms where spoken sessions are scheduled; both PC and Mac computers will be available for use. Presenters may bring their own computers and set them up BEFORE the start of the session in which they are presenting. A switchbox 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 session room a minimum of 30 minutes before their talks so that they know how to set up their equipment. Overhead projectors will NOT be provided.

Baggage Check

Baggage Check with the Palmer House Hilton Hotel Bellman for attendees who are registered guests is available in the lobby.

Business Center

The Palmer House Hilton Hotel has a Self Service Business center located on the 7th Floor with complimentary Internet Access and Printer available 24-Hours. There is a Full service UPS Business Center located near the Main Entrance.

Catering

Complimentary food and beverage service is available to all registered attendees at the following times in the Exhibit Hall. It is included in the registration fee. Please refer to the table below for the catering times.

	Saturday, March 31	Sunday, April 1	Monday, April 2	Tuesday, April 3
Receptions	GAM and Welcome Reception *Exhibit Hall* 5:30 - 6:30 pm	DCC Reception *Exhibit Hall* 4:00 - 5:00 pm		
Continental Breakfasts		*Exhibit Hall* 8:00 am - 8:30 am	*Exhibit Hall* 8:00 am - 8:30 am	*Exhibit Hall* 8:00 am - 8:30 am
Coffee Breaks		*Exhibit Hall* 2:30 pm - 3:00 pm	*Exhibit Hall* 2:30 pm - 3:00 pm	*Exhibit Hall* 3:00 - 3:30 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 and your symposium speakers are available in your presentation room at least thirty minutes before the start of the session. Persons chairing sessions will be asked to keep the talks on time.

Coat, Baggage & Poster Check

We do not provide this service; if anyone wishes to leave something under a table for safekeeping they should do so at their own risk. It is not our responsibility if things are lost or stolen.

Contact Us

To contact us onsite, visit the Registration Desk in the Ballroom Foyer of the Palmer House Hilton Hotel, or send

an email to meeting@cnsmeeting.org We will respond to your email at our soonest opportunity.

Drink Tickets

Each Attendee will receive two drink tickets, they can be redeemed for alcoholic or non-alcoholic beverages at the GAM and Welcome Reception on Saturday or at the Distinguished Career Contributions Award in Cognitive Neuroscience (DCC) Reception on Sunday. Lost drink tickets may not be replaced.

Exhibit Hall

The conference exhibit is located in the Exhibit Hall of the Palmer House Hilton Hotel. Located in this room are the posters, exhibit booths, and catering. The Exhibit Hall is open at the following times:

Saturday, April 2	5:30 - 7:30 pm*
Sunday, April 3	8:00 - 10:00 am 1:00 - 3:00 pm 4:00 - 6:00 pm*
Monday, April 4	8:00 - 10:00 am 1:00 - 3:00 pm 5:00 - 7:00 pm*
Tuesday, April 5	8:00 - 10:00 am 3:00 - 5:00 pm*

*Please note the room will close and lock sharply; there is no admittance until the following day.

Facebook

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Future Meetings

Please join us for the annual CNS meeting in San Francisco on April 13 - 16, 2013, celebrating our 20th Anniversary.

Hotel

The Palmer House Hilton Hotel is our exclusive Hotel for the CNS 2012 Annual Meeting. It is located at 17 East Monroe Street, Chicago, Illinois, United States 606031.

Hotel Restaurants

The Palmer House Hilton Hotel offers several meal options for all tastes and budgets. A variety of delicious dining options are available for you to choose from.

Hotel Lobby

Neatly tucked away just off the picturesque lobby is an enclave of comfort and elegance. Following in a tradition of perfectly poured martinis and warm, inviting conversation, the lobby bar is the ideal setting to reconnect with colleagues or reminisce with friends. Take a break and enjoy a cup of tea. Afternoon Tea is offered in the Lobby of the Palmer House from 2 pm - 4 pm daily. Reservations are required. Make your reservations today by calling Lockwood Restaurant at 312.917.3404. Hours: Opens Daily at 11am.

Lockwood Restaurant

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Lockwood Restaurant and Bar is open for:

Breakfast: 6:30am - 11am
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Lunch: Mon thru Fri 11am - 2pm, Sat & Sun 11am - 3pm
Dinner Prix Fixe: 5pm - 7pm
Dinner: Sun thru Thu 5pm - 10pm, Fri & Sat 5pm - 11pm

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This posh new split-level bar offers a sumptuous setting to see and be seen in downtown Chicago. Sink into one of the plush leather sofas and enjoy the scene as you mingle with friends over your favorite cocktail. Potter's Lounge offers the finest libations along with a top-shelf experience befitting Chicago's most famous hotel. Potter's Lounge is open Wednesday thru Saturday at 4pm.

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Free Internet terminals are located in Foyer near the CNS Registration Desk. Internet terminals are available during meeting registration hours on Saturday, Sunday, Monday and Tuesday when not needed for onsite registration. See Onsite Meeting Registration. There is complimentary Wireless Internet Access in the Lobby of the Palmer House Hilton Hotel, see hotel personnel for info.

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Please check with the CNS Registration Desk for any items lost and found.

Meeting Rooms

All meeting rooms for symposia and Slide/GSA/PFA sessions are located in the Palmer House Hilton Hotel.

Member Services

The member services desk is located in Foyer Area of the Palmer House Hilton Hotel. The member services desk will be open at the following times:

Saturday, March 31 7:30 am - 4:00 pm
Sunday, April 1 7:30 am - 4:00 pm
Monday, April 2 7:30 am - 4:00 pm
Tuesday, April 3 8:00 am - 2:00 pm

Messages

A bulletin board will be available for messages and job postings near the CNS Registration Desk in the Ballroom Foyer.

Mobile Phones

Attendees are asked to silence their mobile phones when in sessions. See also phone charging station.

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Onsite Meeting Registration

The CNS Registration Desk is located in the Ballroom Foyer Area of the Palmer House Hilton Hotel. The registration desk will be open at the following times:

Saturday, March 31, 12:00 - 7:30 pm
Sunday, April 1, 7:30 am - 6:00 pm
Monday, April 2, 8:00 am - 7:00 pm
Tuesday, April 3, 8:00am - 5:00 pm

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There will be a small phone charging station located at the Registration desk in the Ballroom Foyer.

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

Poster Sessions

Poster sessions are scheduled on Saturday, March 31, Sunday, April 1, Monday April 2 and Tuesday, April 3. The presenting author must be present during the assigned session and the other authors may be present during the remaining time to be available to answer any questions. The poster sessions are in the Exhibit Hall in the Palmer House Hilton Hotel. Badges are required at all times. Do not leave personal items in the poster room.

Printed Program

Attendees were given the option to opt-out of getting a program during registration. Attendees who opted out will not receive a program; however they may come back Tuesday afternoon to see if any extra programs are available. One copy of the printed program is available to each attendee who requested one. If you would like a second copy please check in at the Registration desk located in the Ballroom Foyer on the last day of the event.

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

Attendees have two options for viewing the program: either downloading it from our website or downloading the CNS Smartphone Application.

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You will receive two receipts online, one from CNS for registration and one from PayPal for payment. See also Certificate of Attendance.

Receptions

The GAM and Welcome Reception will be held in the Exhibit Hall of the Palmer House Hilton Hotel, from 5:30-6:30 pm on Saturday, March 31. The Distinguished Career Contributions Award in Cognitive Neuroscience (DCC) Reception will be held Sunday, April 1 at 4:00-5:00 pm in the Exhibit Hall.

Registration Hours

The Registration Counter is located in the Ballroom Foyer of the Palmer House Hilton Hotel. The Registration Counter will be open at the following times:

Saturday, March 31 12:00 - 7:00 pm
Sunday, April 1 7:30 am - 6:00 pm
Monday, April 2 8:00 am - 7:00 pm
Tuesday, April 3 8:00 am - 5:00 pm

Registration Rates

2012 Meeting Registration Rates:

	Regular Member	Post-Doc	Student	Non-Member
Discounted Early Registration through Feb. 1, 2012	$290	$210	$100	$400
Regular Registration February 2 - March 12, 2012	$345	$225	$125	$445
Onsite Registration After March 12, 2012	$420	$300	$170	$495

See Onsite Meeting Registration for any questions.

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Restaurant information is located at the Concierge Desk in the Hotel Lobby with knowledgeable staff providing up-to-date Chicago dining and tourism information.

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Chicago-O'Hare International Airport: About 18 miles from the Hotel. Drive time: 35-60 min.

Chicago Midway Airport: About 12 miles from the Hotel. Drive time: 30-45 min.

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Chicago Water Taxi - Take a convenient Chicago Water Taxi to see some of Chicago's top attractions in a whole new way! The Chicago Water Taxi offers a fun, fast and friendly direct link from the Metra and Amtrak commuter train stations at Madison Street to Michigan Avenue, the Magnificent Mile, River North Arts District at LaSalle Street and Chinatown. One-way fares start at $2; for schedule and complete fare details, visit http://www.chicagowatertaxi.com or call 312.337.1446.

Taxi Cabs - There are no flat rates because all taxicabs run on meters. Expect to spend approximately $35 to $40 for a taxicab ride to the Airport. For wheelchair accessible vehicles, please call United Dispatch at 1-800-281-4466.

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American United Cab Association	773-327-6161
Blue Ribbon Association, Inc.	773-508-9100
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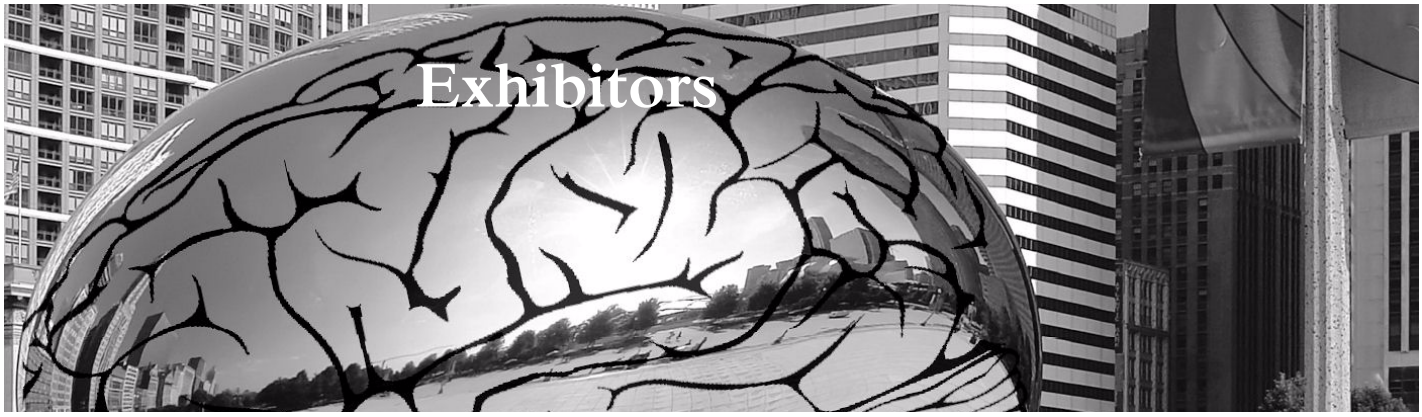

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CNS 2012 Exhibitors

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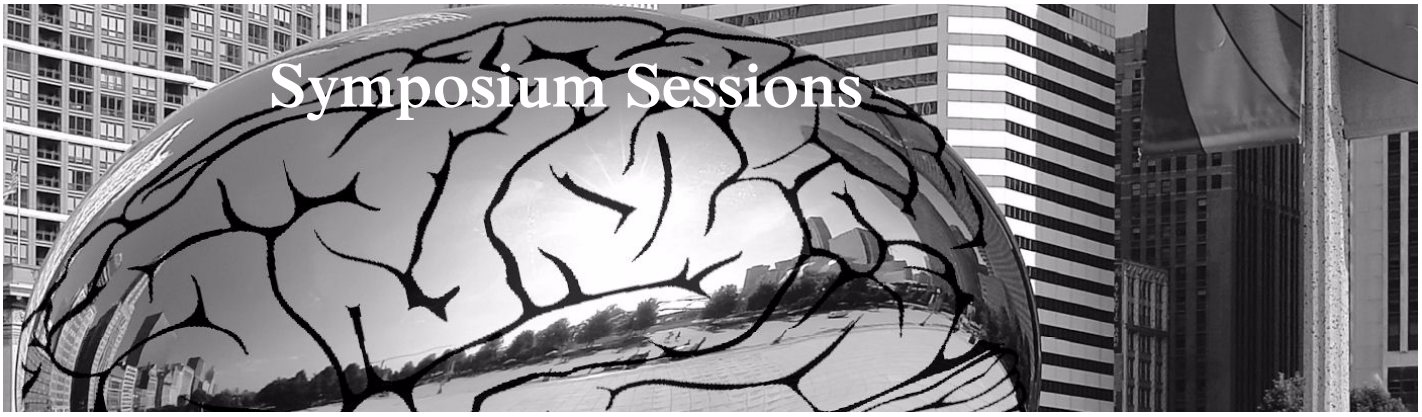
Exhibit Hall Hours

Saturday, April 2	5:30 - 7:30 pm
Sunday, April 3	8:00 - 10:00 am 1:00 - 3:00 pm 4:00 - 6:00 pm
Monday, April 4	8:00 - 10:00 am 1:00 - 3:00 pm 5:00 - 7:00 pm
Tuesday, April 5	8:00 - 10:00 am 3:00 - 5:00 pm



Symposium Session 1

EMOTION'S IMPACT ON COGNITION – DISSOCIATING ENHANCING AND IMPAIRING EFFECTS

Sunday, April 1, 10:00 am - 12:00 pm, Grand Ballroom

Chair: Florin Dolcos, Unversity of Illinois at Urbana-Champaign
Co-Chair: Mara Mather, University of Southern California
Speakers: Mara Mather, Elizabeth A. Kensinger, Florin Dolcos, Guillen Fernandez

Emotion is a "double-edged sword" that can either enhance or hinder various aspects of our cognition and behavior. Sometimes, even the same type of emotionally arousing event can lead to opposite effects in different contexts. Current models of the brain mechanisms of emotion and memory can account for enhanced memory for emotionally arousing stimuli via the modulating effects of the amygdala, but they do not explain impairments as clearly. For instance, what neural mechanisms lead to the memory trade-offs in which scenes are remembered less well when shown behind emotionally arousing images? How can we account for the fact that sometimes arousal enhances and sometimes it impairs memory for neutral stimuli seen just beforehand? Why would arousal and stress enhance long-term memory but impair working memory? The present symposium provides new evidence to help resolve these issues. First, Mara Mather will introduce evidence for the arousal-biased competition (ABC) theory, which accounts for both impairing and enhancing effects of arousal on memory. Next, Elizabeth Kensinger will discuss evidence concerning the neural correlates of trade-offs produced by emotion on memory for central vs. peripheral details. Then, Florin Dolcos will present evidence from studies investigating the neural correlates of opposing immediate vs. long-term effects of emotional distraction on perception & working memory vs. episodic memory. Finally, Gillen Fernandez will discuss findings from studies investigating the impact of stress on attention and memory. These talks each help address the basic mechanisms of when emotion enhances and when it impairs attention, perception, and memory.

ABSTRACTS

AROUSAL-BIASED COMPETITION IN MEMORY Mara Mather[1], Matthew Sutherland[1], Tae-Ho Lee[1], Allison Foertsch[1], Marisa Knight[1]; [1]University of Southern California — The standard cognitive neuroscience account of how arousal affects memory is that the amygdala facilitates memory operations in other brain regions, such as the hippocampus. This account explains enhanced memory for emotionally arousing stimuli. However, it does not explain why sometimes memory is enhanced and sometimes impaired for neutral information processed before, during or after the arousing stimulus. Arousal-biased competition (ABC) theory accounts for both the impairing and the enhancing effects of arousal by positing that arousal biases competition to enhance high priority information and suppress low priority information. Priority is determined by both bottom-up salience and top-down goal relevance. In this talk, I present evidence of ABC effects in both initial learning and in memory consolidation. In initial encoding, arousal enhances short-term memory for high-contrast letters while impairing memory for low-contrast letters, revealing that arousal affects the encoding of high and low salience stimuli in opposite ways. Furthermore, during learning, neural tuning curves representing perceptually salient stimuli are sharpened whereas those representing non-salient stimuli are widened by concurrent arousal. Such effects lead visual search for a salient target to be more effective under arousing than under non-arousing conditions whereas visual search for a non-salient target is less effective under arousing conditions. The effects of arousal extend to long-term memory consolidation, as well. Manipulating the top-down or bottom-up priority of neutral stimuli seen before an arousing stimulus determines whether long-term memory consolidation for those stimuli will be enhanced or impaired.

EMOTION-INDUCED MEMORY TRADE-OFFS Elizabeth A. Kensinger[1], Jessica D. Payne[2], Jill Waring[1], Katherine Mickley Steinmetz[1]; [1]Boston College, [2]University of Notre Dame — After studying scenes that contain an emotional or a neutral item placed on a non-emotional background, participants often show better memory for the emotional (vs. neutral) item and worse memory for the background on which an emotional (vs. neutral) item was placed. This pattern has been referred to as a memory trade-off, because memory for the scene background is traded off in favor of memory for the emotional item. This talk will describe two series of studies that we have conducted to examine the role of encoding processes, and of affective state during encoding, on the magnitude of the trade-off. The first set of studies used fMRI to clarify how neural processes engaged during encoding could yield this trade-off. The results of these studies have revealed that activity in the amygdala and orbitofrontal cortex corresponded with good memory for items, but not for backgrounds, and that activity in regions associated with visual processing and visual attention led to forgetting of the accompanying background. The second set of studies examined the effect of anxiety on the trade-off, both by examining variation in anxiety levels among healthy individuals and by examining the trade-off in individuals with PTSD. The results emphasize that anxiety during encoding can exacerbate the trade-off, but that strategies can also be implemented to reduce the pervasiveness of the effect. The implications of these findings for understanding the effects of arousal on memory will be discussed.

NEURAL CORRELATES OF OPPOSING MODULATION OF EMOTION ON PERCEPTION & WORKING MEMORY VS. EPISODIC MEMORY Florin Dolcos[1], Andrea T. Shafer[2], Gregory McCarthy[3], Roberto Cabeza[4]; [1]University of Illinios at Urbana-Champaign, [2]University of Alberta, [3]Yale University, [4]Duke University — An important question in the emotion literature concerns the link between immediate (impairing) effects of emotional distraction (ED) on perception & working memory (WM) and long-term (enhancing) effects of emotion on episodic memory (EM) for the distracters. Most previous studies investigated these opposing effects in isolation, and hence it is not clear to what extent some of the brain regions identified contribute to one or both of these effects. Concomitant investigation of these effects is critical, as they typically co-occur in both normal and clin-

ical conditions. For instance, increased distraction by the scene of a tragic accident while driving may also initiate the mechanisms that lead to better memory for the incident. Similarly, enhanced memory for and rumination on distressing events may contribute to increased ED and impaired cognition in affective disorders. Our studies simultaneously investigating these issues in healthy participants identified common amygdala engagement in both immediate and long-term effects, but its involvement was linked to opposite effects in brain regions associated with impaired WM (reduced dorsolateral prefrontal cortical activity) vs. enhanced EM performance (increased hippocampal activity). Moreover, the link between the immediate and long-term effects was dependent on the availability of processing resources at encoding, with ED being greatest when processing resources were most available while EM being highest when processing resources were least available. These results suggest common and dissociable mechanisms underlying opposing immediate vs. long-term effects of emotion on perception & WM vs. EM, respectively, which will be discussed in conjunction with evidence from clinical studies.

EQUIPPED TO SURVIVE: LARGE-SCALE FUNCTIONAL REORGANIZATION IN RESPONSE TO THREAT ENABLES OPTIMAL BEHAVIOR Guillen Fernandez[1], Hein J.F. van Marle[1], Marloes J.A.G. Henckens[1], Shaozheng Qin[1], Erno J. Hermans[1]; [1]Radboud University Nijmegen — In response to acute environmental adversity, organisms rapidly shift into a state that is optimal to detect and react to imminent threat. To identify underlying neural network dynamics and neuromodulatory mechanisms we combined in a series of studies fMRI with thread based stress induction procedures and pharmacological manipulation. Our data show that acute psychological stress increases responsiveness and interconnectivity within a salience related network as a function of stress response magnitudes. Beta-adrenergic receptor blockade, but not cortisol synthesis inhibition, diminished this increase. These findings reveal that noradrenergic activation during acute stress results in coupling within a distributed network that integrates information exchange between regions involved in autonomic-neuroendocrine control and vigilant attentional reorienting. This reorientation causes tonic amygdala activity and phasic responses to biologically salient stimuli while the functional connectivity to the locus coeruleus, the medial prefrontal cortex and the anterior insula is enhanced. This response goes along with higher amygdala sensitivity to threatening stimuli, but lower specificity. This heightened sensitivity is critical for survival when an individual is threatened, but cognitive elaboration would slow down appropriate reactions. Accordingly, further experiments show that acute stress leads to working memory impairments and prefrontal cortex down regulation. This instantaneously occurring reorganization affecting the amygdala and the prefrontal cortex is normalized by dynamically changing corticosteroid-related mechanisms. This pattern of results reveals basic principles of how we respond when our survival is at stake. It provides a mechanistic account for an acute central nervous stress response and its normalization.

Symposium Session 2

USING NON-INVASIVE BRAIN STIMULATION TO ENHANCE COGNITIVE AND MOTOR ABILITIES IN THE TYPICAL, ATYPICAL, AND AGING BRAIN

Monday, April 2, 10:00 am - 12:00 pm, Grand Ballroom

Chair: Roi Cohen Kadosh, University of Oxford

Speakers: Roi Cohen Kadosh, Jenny Crinion, Paulo S. Boggio, Leonardo G. Cohen

There is perennial interest in the neuroscience community in using our expanding understanding of the brain to devise ways of enhancing brain functions, and consequently, human abilities. Most existing efforts to improve human abilities have focused on pharmacological interventions. However, recently there has been a burst of research exploring whether non-invasive brain stimulation (NIBS) might be beneficial. This symposium will capture the new advances in the use of NIBS with relevance for scientists working in a variety of areas. The talks will reflect the breadth and depth of current progress and highlight research demonstrating the applicability of NIBS in the enhancement of a variety of abilities ranging from basic functions to high-level cognition in healthy adults, adults with congenital or acquired brain dysfunction, and elderly patients. Cohen Kadosh will present data showing enhancement in basic and advanced mathematical abilities in adults with and without dyscalculia and the neural mechanism underlying this enhancement. Crinion will provide behavioural and neuroimaging evidence of speech enhancement, and the potential use of NIBS in patients with anomia. Boggio will show evidence for memory enhancement following NIBS in elderly patients with degenerative illnesses such as Parkinson's or Alzheimer's disease. Finally, Cohen will describe the latest experimental interventions being developed to manipulate neuroplasticity and enhance motor rehabilitation. Together, these presentations mark future directions in behavioural enhancement in different domains and populations, and expand our understanding of basic research findings in these fields with clear translational benefits for the field of applied research.

ABSTRACTS

USING NON-INVASIVE BRAIN STIMULATION TO ENHANCE NUMERICAL ABILITIES Roi Cohen Kadosh[1]; [1]University of Oxford — Numbers are the lingua franca in science, economics, sports, education, and everyday life. In this study we examined: 1) whether we can improve numerical abilities in healthy adults as well as people with numerical learning disabilities (dyscalculia); and 2) what the underlying neurocognitive mechanisms that involved in such enhancement are. In a series of experiments with healthy adults we found that it is possible to enhance basic numerical abilities as well as more advanced numerical abilities, such as complex calculation, using transcranial direct current stimulation (tDCS) to the parietal lobes or the dorsolateral prefrontal cortex (DLPFC). The observed improvement lasted up to 6 months after tDCS, and was specific to the trained material. At the neural level, using concurrent tDCS and near infrared spectroscopy (NIRS), we found that tDCS to the DLPFC during numerical training enhanced performance by increasing the level of oxygenated hemoglobin in the DLPFC specifically, but not in nearby regions. Last, our research on participants with dyscalculia indicated that they benefit from receiving tDCS during numerical training. However, tDCS to people with dyscalculia was effective only when we targeted different brain regions than those associated with enhanced performance in the typical population. This suggests that people with dyscalculia recruit different brain areas for numerical processing, probably due to brain reorganization. Cumulatively, these experiments advance our understanding of how numerical abilities are subserved in the typical and atypical brain, and provide a possible means to improve numerical cognition, thus having important implications for education, intervention, and rehabilitation.

EXAMINING THE POTENTIAL OF TRANSCRANIAL DIRECT CURRENT STIMULATION FOR ENHANCING SPEECH PRODUCTION IN HEALTHY SUBJECTS AND NEUROLOGICAL PATIENTS Jenny Crinion[1]; [1]University College London — Application of transcranial direct current stimulation (tDCS) in humans can have significant and selective behavioral consequences that are associated with the cortical location of the stimulation electrodes and the task engaged during stimulation. However, the mechanism by which tDCS affects human behavior is unclear. Recently, functional magnetic resonance imaging (fMRI) has been used to determine the spatial topography of tDCS effects, but no behavioral data were collected during stimulation. I will report findings from fMRI studies in which we recorded both neural and behavioral responses using a novel combination of left frontal Anodal-TDCS (A-TDCS) and an overt picture-naming task. In particular, I will focus on results from healthy subjects and chronic aphasic stroke patients who suffer from word finding problems (anomia). In the healthy subjects I will show that on-line A-tDCS

had significant behavioral and regionally specific neural facilitation effects. Furthermore, faster naming responses correlated with decreased blood oxygen level-dependent signal in Broca's area. In the patients whose lesions spared Broca's area I will discuss the application of A-TDCS to this region as an adjuvant method to computer delivered speech rehabilitation techniques. Together, these data support the importance of Broca's area within the naming network and offer a better understanding of the neural facilitation effects of A-tDCS and its interaction with specific cognitive tasks. This represents a significant advancement for basic and applied research in the field.

MEMORY ENHANCEMENT VIA TRANSCRANIAL DIRECT CURRENT STIMULATION IN ELDERLY WITH DEGENERATIVE ILLNESSES Paulo S. Boggio[1]; [1]Mackenzie Presbyterian University, São Paulo, Brazil — Several studies have shown that memory can be modulated and enhanced by non-invasive brain stimulation. In this talk I will present the suitability of using transcranial direct current stimulation (tDCS) to enhance working memory in Parkinson's disease (PD) patients or to improve visual recognition memory in Alzheimer's disease (AD) patients. In PD patients we investigated the effects of stimulating the left DLPFC using tDCS. We found an improvement in their working memory abilities as indicated by an increase of 20% in their performance in a 3-back task. In AD patients we investigated the effects of left temporal cortex and left DLPFC cortex tDCS as compared to sham stimulation in a visual recognition memory task. We found an increase of 18% and 13% in visual recognition memory after left temporal cortex tDCS and left DLPFC tDCS, respectively, as compared to sham. In both experiments, patients performed the tasks while receiving anodal stimulation (to induce facilitatory effects). Therefore, the observed effects might be due to an enhancement of the local cortical excitability at the stimulated brain area. Importantly, the effects of tDCS are task-dependent, as tDCS is only responsible for priming the area to receive additional behavioural intervention. These studies demonstrate the potential of tDCS for memory improvement in elderly with PD or AD, and open a venue for future studies to examine the potential long-term effect of this behavioral improvement.

USING REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION TO STUDY THE UNDERLYING NEURAL MECHANISMS OF HUMAN MOTOR LEARNING AND MEMORY IN NEUROREHABILITATION Leonardo G. Cohen[1]; [1]National Institutes of Health (NIH) — In the last two decades, there has been a rapid development in the research of the physiological brain mechanisms underlying human motor learning and memory. While conventional memory research performed on animal models uses intracellular recordings, microfusion of protein inhibitors to specific brain areas and direct induction of focal brain lesions, human research has so far utilized predominantly behavioral paradigms and indirect measurements of neural activity. We examined the mechanisms of learning and memory in the lesioned brain using repetitive transcranial magnetic stimulation (rTMS), a safe non-invasive brain stimulation technique. We used rTMS to study the functional role of specific cortical areas by evaluating the behavioral consequences of selective modulation of activity (excitation/inhibition) on memory generation and consolidation, contributing to the understanding of the neural substrates of motor learning. Depending on the parameters of stimulation, rTMS can also facilitate learning processes, presumably through purposeful modulation of excitability in specific brain regions. rTMS has also been used to gain valuable knowledge on the timeline of motor memory formation, from initial encoding to stabilization and long-term retention. Here, we summarize insights gained using rTMS on the physiological and neural mechanisms of human motor learning and memory. In particular, rTMS has contributed to start dissociating the mechanisms of consolidation and reconsolidation in stroke patients. Understanding of these mechanisms, due in part to the use of rTMS is allowing us to start facilitating excitability in brain regions specifically involved in memory formation and modification in patients with brain lesions as well as healthy subjects.

Symposium Session 3

MUSIC AS A MEDIUM FOR PERCEPTION AND ACTION

Monday, April 2, 3:00 - 5:00 pm, Grand Ballroom

Chair: Psyche Loui, Beth Israel Deaconess Medical Center and Harvard Medical School

Speakers: Peter Pfordresher, Psyche Loui, Caroline Palmer, Peter Keller

Recent years have seen a surge of interest, both in the public and among researchers, in the study of music and the brain. While some view music as the only art form that can showcase talent, stimulate movement, and mobilize crowds through auditory stimulation alone, to the CNS community music may be viewed as an organizing principle through which we can investigate multiple behavioral and neural functions. In this symposium we explore the question of how music can inform us about the coupling between perception and action in the brain. In addition to localizing and modeling the computations of the perception-action network, we document its impairments and implications for interpersonal interactions in the auditory environment. The topic of pitch production is introduced by Pfordresher, who describes studies on vocal psychophysics of poor pitch singing. Loui follows up on the topic of pitch by presenting behavioral and neuroimaging results that converge towards an auditory-motor network for pitch, which is disrupted in tone-deafness. As a parallel, Palmer defines an auditory-motor network for rhythm, and describes a computational model based on synchronicity and its implications on beat-deafness. This notion of synchronicity will be followed up by Keller, who will describe behavioral and fMRI studies on skills required for interpersonal aspects of musical performance. Due to its interdisciplinary nature, its broad general appeal, and its overlap with perception, attention, memory, neuroplasticity, higher cognition, language, development, and social neuroscience, we believe that the proposed symposium will be of great interest to the CNS community.

ABSTRACTS

POOR-PITCH SINGING AS A DEFICIT OF INVERSE MODELING? BEHAVIORAL EVIDENCE AND NEURAL PREDICTIONS Peter Pfordresher[1]; [1]University at Buffalo, State University of New York — Although recent evidence suggests that most humans can vocally imitate pitch patterns while singing, a significant minority of individuals consistently mistune while singing, or while imitating spoken pitch. We report three experiments based on the hypothesis that poor-pitch singing is a deficit involving the ability to plan vocal motor gestures based on anticipated target pitches: a variant of the inverse modeling problem in motor control. If so, vocal imitation deficits among poor pitch singers should be reduced (or even absent) when poor-pitch singers imitate their own vocalizations as opposed to those of other individuals, based on the fact that self-imitation can be performed based on Hebbian learning rather than inverse modeling. In each experiment, participants vocally imitated recordings of themselves (from an earlier session) or of other singers (from previous data sets). Analyses were based on how accurately participants imitated the target F0 pattern in both relative and absolute pitch. All participants were more accurate at imitating their own recordings than those of others. However, this advantage was larger for poor-pitch singers than for accurate singers. Furthermore, this advantage does not seem to be contingent on self-recognition or timbral similarity (Experiment 2), and remains if the recording is transposed in pitch (Experiment 3). Such effects imply that poor-pitch singers may have a deficit in the use of the cerebellum for inverse modeling, in addition to deficits of sensorimotor associations documented previously.

PERCEPTION AND ACTION OF MUSICAL PITCH: BEHAVIORAL, DTI AND FCMRI STUDIES IN CHILDREN AND TONE-DEAF ADULTS Psyche Loui[1]; [1]Beth Israel Deaconess Medical Center and Harvard Medical School — Although musical ability is celebrated in all cultures and generations, a subset of the normal population shows a lack of musical ability, with deficits in pitch perception and production. These individuals provide a

window into the perception and action coupling that is required for music. I will present results from four experiments on the role of the auditory-motor network in linking perception and action for pitch: 1) A psychophysical study on pitch perception and production, showing that tone-deaf individuals cannot consciously perceive what they can produce, suggesting a functional dissociation between perception and production pathways in the brain. 2) A DTI study on tone-deafness, showing that the arcuate fasciculus, a white matter tract that connects perception regions (superior and middle temporal gyri) and production regions (inferior temporal gyrus), is smaller in tone-deaf individuals than controls. 3) A behavioral study showing that the degree of perception-production congruence predicts phonemic awareness scores in 7-9-year-old children. 4) Preliminary results from resting state functional connectivity MRI in children, showing that individuals with more congruity between perception and production have higher functional connectivity between frontal and temporal regions. Taken together, results show that an auditory-motor network supports congruence between perception and action: this network includes IFG, STG, MTG, and arcuate fasciculus. The perception-action network increases in efficiency throughout development and is crucial for music and for speech-and-language. Importantly, the congruence between perception and production may hold more explanatory power for DTI and rsfMRI data than perception or production alone.

TEMPORAL DYNAMICS OF AUDITORY-MOTOR INTEGRATION IN MUSIC PERFORMANCE Caroline Palmer[1]; [1]McGill University — Musicians demonstrate exquisite auditory-motor integration, sometimes attributed to expertise acquired with years of training. However, humans with and without training exhibit fine synchronization as they clap to a song, hum with a tune, or sway to a beat. The fact that even untrained individuals can respond to a beat is remarkable because these perceived periodicities arise in music performances that are not periodic. We examine this ability in one line of research on how musicians entrain to a temporally changing beat, a strong case of perceptual invariance in the face of changing temporal variation. A dynamical systems model accurately predicted the temporal performance of pianists who synchronized with a changing auditory signal, based on period and phase coupling. A second line of research demonstrated that pianists who shared preferred rates in solo performance, modeled with natural (resonant) frequencies that reflect the neural response of an oscillation when exposed to a periodic stimulus, displayed better temporal adaptation to their partner in duet performance. A final experiment compared individuals' abilities to synchronize with phase and period (tempo) perturbations with those of a previously reported beat-deaf individual. The dynamical systems model applied to the beat-deaf case indicated deficits in an intrinsic tapping frequency that adapts in response to temporal perturbations, compared with the control subjects. These findings with expert musicians, non-experts and disordered individuals support models of temporal adaptation based on an entrainment of internal neural oscillations with exogenous drivers that transcends specific training.

NEURAL UNDERPINNINGS OF MUSICAL ENSEMBLE SKILLS Peter Keller[1,2], Merle Fairhurst[1], Nadine Pecenke[1], Marie Uhlig[1], Annerose Engel[1,3]; [1]Music Cognition & Action Group, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]MARCS Auditory Laboratories, University of Western Sydney, Australia, [3]The Netherlands Institute for Neuroscience, Royal Netherlands Academy of Arts and Sciences (KNAW), Amsterdam, The Netherlands — Musical ensemble performance is a form of interpersonal behavior wherein the actions of multiple individuals are typically coordinated precisely in time. Such coordination is facilitated by links between perception and action to the extent that each musician's movements must be controlled so as to produce sounds that are synchronized with sounds produced by co-performers. Perception-action coupling may serve to scaffold the cognitive/motor skills that underlie this process. A series of experiments employed functional magnetic resonance imaging to test for overlap in the brain regions subserving three basic ensemble skills related to anticipation, adaptation, and attention. In one experiment, musicians synchronized finger taps with tempo-varying auditory sequences while their ability to anticipate the tempo changes was taxed by a concurrent task. A second experiment investigated adaptive timing by requiring musicians to tap in synchrony with auditory pacing sequences that adapted to the participants' tap timing by varying degrees. A third experiment varied attentional demands in a task that required musicians to judge leader/follower relations in a piano duet. The main loci of overlap in activations associated with modulations of the three ensemble skills were in the cerebellum (which may house internal models that guide action control) and the inferior frontal cortex (which plays a role in perception-action coupling, sensorimotor simulation, and cognitive control). This finding is consistent with the hypothesis that the cognitive/motor processes that support ensemble coordination may interact via the joint operation of internal models related to one's own actions and another class of models that simulate co-performers' actions.

Symposium Session 4

THE BRAIN ON FOOD: INVESTIGATIONS OF MOTIVATION, DOPAMINE AND EATING BEHAVIORS

Tuesday, April 3, 10:00 am - 12:00 pm, Grand Ballroom

Chair: Laura Martin, University of Kansas Medical Center
Speakers: W. Kyle Simmons, Susan Carnell, Dana M Small, Laura M Holsen

Food is a highly motivating stimulus in our environment. We eat for many non-homeostatic reasons, such as celebration, comfort, and hedonic pleasure. Novel investigations of the neural basis of healthy and disordered eating reveal that throughout the multisensory process of food consumption, sensory, reward processing and cognitive control brain regions work together to keep track of how rewarding the experience is and help us decide whether or not to continue eating. A complete cognitive neuroscience model of food motivation requires understanding the sensory, reward, and cognitive mechanisms associated with healthy eating, and how those mechanisms can run amok. The first talk will review recent fMRI studies in lean individuals which identify how neural systems involved in retrieving food taste and reward information contribute to food motivation and food-related decision making. The second talk describes a study that uses multi-modal (visual and auditory) food cues to examine a dynamic, distributed reward-related network specifically associated with subjective ratings of cue-induced desire to eat in lean and obese women. The third talk provides evidence suggesting that overweight individuals show deficits in dopamine-dependent learning, as indicated by reduced error signal generation in the OFC and ventral striatum, and impaired insula-mediated flavor-nutrient conditioning. The final talk will bring together evidence across the spectrum from healthy to disordered eating behaviors by examining the neural circuitry underlying differences in food motivation between anorexia, healthy weight, obese, and Prader-Willi syndrome populations. Together, the talks will provide a stimulating introduction to the networks involved in food motivation.

ABSTRACTS

MAPPING THE NEURAL SYSTEMS UNDERLYING CONCEPTUAL REPRESENTATIONS OF FOOD W. Kyle Simmons[1]; [1]Laureate Institute for Brain Research — Simply perceiving a food-related stimulus results in the obligatory, automatic retrieval of that food's salient properties, namely how it tastes, and how rewarding it would be to eat. The retrieval of this information likely plays an important role in food-related decision-making and food abstinence. In my talk I will present recent findings from functional Magnetic Resonance Imaging (fMRI) studies examining activity within the neural systems that underlie the retrieval of food taste and food reward information. Particular attention will be paid to the insular cortex's role in the retrieval of food taste properties, and the roles played

by orbitofrontal cortex and the midbrain striatal-pallidal neurocircuit in food reward.

THE NEURAL BASIS OF APPETITE: FMRI ACTIVATION AND FUNCTIONAL CONNECTIVITY IN RELATION TO DESIRE TO EAT FOLLOWING HIGH-CALORIE FOOD STIMULI Susan Carnell[1,2,3], Leora Benson[1,2,3], Spiro Pantazatos[1,2,3], Moe Sharafi[1,2,3], Talya Ladell[1,2,3], Joy Hirsch[1,2,3], Allan Geliebter[1,2,3]; [1]New York Obesity Nutrition Center, [2]St. Luke's-Roosevelt Hospital, [3]Columbia University — Obesity is associated with heightened neural responses to high-calorie food stimuli, which may correspond to increased subjective appetite and externally-cued eating. Eighteen women (BMI 20-41) were presented with auditory (spoken word) and visual (picture) cues representing high-calorie foods and non-foods, and verbally rated desire to eat (DTE) following each block. We then regressed appetite differences following foods vs. non-foods on differences in activation and functional connectivity averaged across visual and auditory conditions. ROI analyses revealed that greater DTE was associated with greater activation in the midbrain and orbitofrontal cortex, and lesser activation in the anterior cingulate. Whole-brain analyses revealed that greater DTE (following foods vs. non-foods) was associated with relatively greater activation in the insula, post-central gyrus, cingulate, and medial frontal gyrus, and relatively lesser activation in the cerebellum, posterior cingulate, middle and superior frontal gyri, thalamus, middle occipital gyrus and lingual gyrus. Psychophysiological interaction analyses using the midbrain as a seed revealed associations between greater DTE and heightened connectivity with the caudate, fusiform/parahippocampal gyrus, hypothalamus, cerebellum and inferior frontal gyrus, along with lesser connectivity with the lingual gyrus and precuneus. Our results suggest externally-cued drive to eat is associated with greater responsivity/crosstalk within regions associated with reward, memory, sensory processing and motor planning, and less responsivity/crosstalk within areas associated with conflict detection, visual/object processing, and motor learning. Our findings represent a step towards describing the functional networks underlying individual differences in appetitive responses to food cues, and support a more nuanced approach to phenotyping in neuroimaging and obesity research.

ASSOCIATIONS BETWEEN ADIPOSITY AND DOPAMINE-DEPENDENT LEARNING PROCESSES Dana M Small[1,2], Maria G Veldhuizen[1,2]; [1]Yale University, [2]The John B Pierce Laboratory — Increased body weight has been associated with reduced dopamine signaling. We investigated the influence of body mass index and percent body fat on response to dopamine-dependent processes; error signal generation and flavor-nutrient conditioning. Error signals are generated when expectation is breached and outcomes are either greater or less than expected. Dopamine neuron firing patterns reflect error signaling and dopamine antagonists disrupt BOLD signals that resemble error signals in the ventral striatum and orbitofrontal cortex in humans. Flavor–nutrient conditioning is a form of classical conditioning in which the flavors of food/drink are associated with post-ingestive effects. Through this learning process human and nonhuman animals learn to prefer flavors associated with calories. Infusion of dopamine antagonists into dopamine source and target regions in rodents disrupts this effect. The neural correlates in humans remain unexplored. We have found evidence of impaired error signal generation and flavor nutrient conditioning in overweight and obese individuals compared to healthy weight individuals. First, we observed a negative association between error-signal generation and body weight in the ventral striatum and orbitofrontal cortex. Second, we found that healthy weight but not overweight or obese individuals learn to prefer flavored drinks associated with 112 vs 0 calories and changes in pleasantness are associated with responses in insular cortex, which are inversely related to percent body fat and BMI. Taken together these data are consistent with prior work showing impaired dopamine signaling in obesity and extend this work by showing that obesity is associated with impaired dopamine dependent learning processes.

FOOD MOTIVATION CIRCUITRY DYSFUNCTION DURING HUNGER AND SATIETY: FROM ANOREXIA NERVOSA TO EXTREME OBESITY Laura M Holsen[1,2], Elizabeth A Lawson[3], Cary R Savage[4], Laura E Martin[4], Amanda S Bruce[5], N Makris, Anne Klibanski[3], Jill M Goldstein[1,2,3]; [1]Harvard Medical School, [2]Brigham and Women's Hospital, [3]Massachusetts General Hospital, [4]University of Kansas Medical Center, [5]University of Missouri Kansas City — Disordered eating is a significant public health issue associated with conditions ranging from self-imposed starvation to obesity. Anorexia nervosa is characterized by severe weight loss; conversely, Prader-Willi syndrome (PWS) is associated with hyperphagia and morbid obesity. However, neuroimaging studies on food reward and motivation have not examined the full spectrum of disordered eating. We describe a series of fMRI studies which investigate brain activity deficits in food reward circuitry regions in response to food images during hunger and satiation in anorexia, healthy-weight controls, simple (non-PWS) obesity, and PWS. During a hunger state, limbic (hypothalamus, amygdala, hippocampus) activation varied significantly between groups (healthy-weight controls as reference group), with significant hypoactivation in anorexia and hyperactivation in simple obesity and PWS. These deficits in subcortical food reward regions persisted following food intake, with additional evidence of hypoactivation in prefrontal inhibitory regions [dorsolateral prefrontal cortex (DLPFC)] in PWS compared to simple obesity. Findings suggest dysfunction in regions associated with hunger, satiation, and food processing in disorders involving abnormal food intake. Reduced activity in anorexia, a disorder of self-starvation, and on the other end of the spectrum, elevated activation in these same regions in PWS, a condition associated with disinhibition around food, provide evidence of a continuum relating food intake behavior/outcomes and food reward circuitry activity. Moreover, inability to recruit the DLPFC after eating may represent what distinguishes PWS, a putative model of extreme obesity, from simple obesity. Taken together, these findings highlight novel neurobiological circuits to target in treatment of anorexia and obesity.

Symposium Session 5

UNDERSTANDING EVENTS: NEW CROSS-DISCIPLINARY RESEARCH

Tuesday, April 3, 1:00 - 3:00 pm, Grand Ballroom

Chair: Timothy Rogers, University of Wisconsin-Madison
Co-Chair: Matt Botvinick, Princeton University
Speakers: Dare Baldwin, Jeffrey M. Zacks, Matt Botvinick, Laurel Buxbaum

Experiments in cognitive neuroscience often involve viewing and responding to individual stimuli, but everyday human behavior has a quite different character: it involves perceiving and understanding the relationships among agents and objects as they interact over time, knowing one's own goals and inferring the goals of others, and interpreting or planning complex sequences of actions. In short, our ability to understand and act in the world depends upon our knowledge about events. Who is doing what to whom, and when, and why? Event knowledge touches on essentially every aspect of cognition, from perception and attention, to language and conceptual knowledge, to planning and decision making, to sequential knowledge and working memory, to theory of mind and social cognition. The advent of cognitive neuroscience has promoted a renaissance of interest in understanding how children and adults learn about events, how events are represented in the mind and brain, and how knowledge about events is used to make predictions, guide action, and shape conceptual representations. Thanks jointly to methodological advances in experimental psychology, functional and structural brain imaging, and computational theory, it is now possible to bring a broad cross-disciplinary approach to the study of this most essential aspect of human cognition. This symposium surveys state-of-the-art empirical and theoretical advances in research on event knowl-

edge from cognitive development, functional brain imaging, neuropsychology and computational modeling.

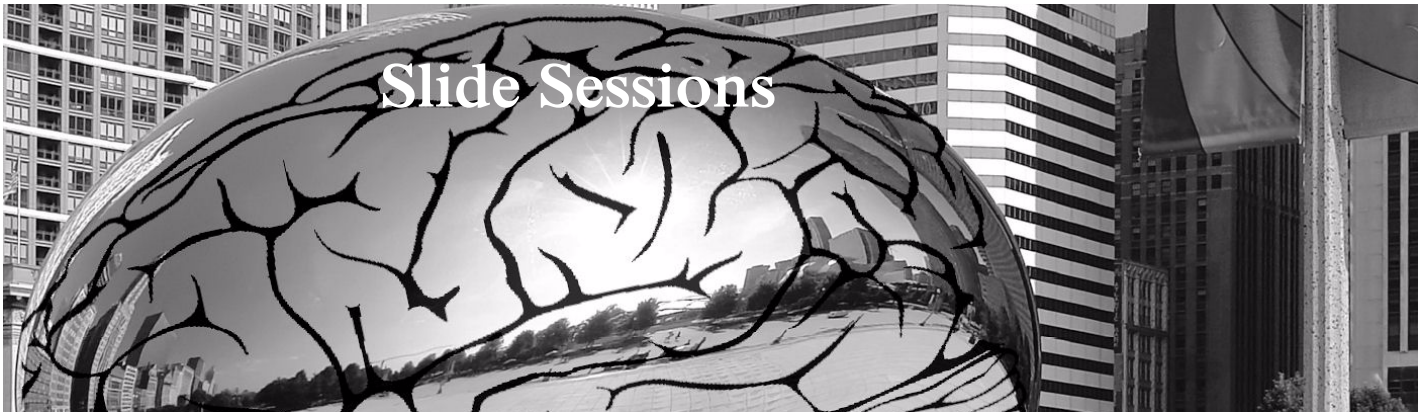
ABSTRACTS

DEVELOPMENT AND EXPERTISE IN ACTION AND EVENT PROCESSING Dare Baldwin[1]; [1]University of Oregon — In the midst of idle conversation on a lazy sunset evening, your neighbor suddenly reaches out and slaps you. Instead of letting loose with invective, you infer an unseen mosquito and smile your gratitude. Such everyday triumphs of action processing showcase the degree to which knowledge (e.g., of mosquitoes and alternative intentional descriptions, in this instance) guides ongoing interpretation of others' actions. I will report on recent research with infants, preschoolers, and adults investigating specific ways in which knowledge shapes action processing. Among other things, we find that acquired expertise plays a role in such basic action-processing skills as identifying action, discovering where one action ends and the next begins, inferring which portions of an event stream are causally efficacious, and monitoring the predictions of goal-directed activity. In current research we are developing a new technique – the dwell-time paradigm – to index changes in attentional allocation as action unfolds. This self-paced slide-show technique is amenable for working with infants and preschoolers as well as adults. New findings reveal that a) observers dwell longer at junctures within unfolding action that are especially informative vis à vis segmental, causal, and goal structure, and b) dwell-time patterns display reorganization as knowledge is acquired. Dwell-times also appear to shed light on subtle but important changes in action processing as expertise grows and development proceeds. For this reason, the dwell-time paradigm also has valuable potential as a behavioral index to facilitate investigation of the neurophysiological concomitants of action and event processing across development.

A ROLE FOR EVENT REPRESENTATIONS IN PERCEPTION, PREDICTION, AND MEMORY-UPDATING Jeffrey M. Zacks[1]; [1]Washington University in St. Louis — Predicting the near future is important for survival; it allows an organism to take advantage of impending opportunity and to avoid impending threat. Prediction plays a central role in current theories of perception, language processing and learning. Event representations — representations of "what is happening now" — may be critical for guiding predictions of what will happen next. I will present a computational and neurophysiological theory of how event representations can improve predictions. The theory states that working memory maintains stable representations of the current event that bias the prediction of some future events over others. Event representations are robust against transient disruptions such as occlusion and distraction, and so can be used to resolve ambiguity and to fill in missing information. Event representations are updated when prediction error suddenly increases; this error-based updating provides a mechanism for adaptively choosing when new information should be loaded into event representations, without any external supervision or teaching signal. Studies of behavioral segmentation and neuroimaging studies of brain activity during event comprehension support the proposal that event segmentation is ongoing and ubiquitous. Evidence for the prediction-based updating mechanism comes from behavioral studies of online prediction during movies of everyday events, and from neuroimaging of activation in midbrain systems associated with broadcasting prediction error. Studies of working memory and episodic memory in healthy adults and clinical populations support the proposal that event segmentation helps determine the structure of later memory.

EVENTS AS CATEGORIES Matt Botvinick[1], Anna Schapiro[1], Natalia Cordova[1], Nicholas Turk-Browne[1], Timothy Rogers[2]; [1]Princeton University, [2]University of Wisconsin-Madison — Recent research into the neural basis of event representation has largely focused on how the brain detects the boundaries that divide events. We pose a related but different question: What binds the elements of an event together? We start by observing that the percepts or actions that constitute an event typically overlap with regard to the percepts and actions that precede and follow them. We hypothesize that this overlap leads the elements of an event to be represented similarly, just as objects with overlapping perceptual and functional properties are represented similarly, giving rise to object categories in semantic cognition. To assess this hypothesis, we describe experiments in which participants were exposed to a sequence of novel stimuli ordered according to a stochastic finite-state grammar. The grammar was constructed so that (a) raw transition probabilities provided no cue to sequence boundaries but (b) subgroups of stimuli were preceded and followed by similar sets of items. We show that participants reliably use transitions between subgroups as cues for sequence parsing. Simple computational models suggest that this behavior can arise when items within subgroups are represented as similar to one another and as distinct from other subgroups. Consistent with this view, repetition-suppression and multi-voxel pattern analyses of fMRI data reveal that brain regions typically associated with sequence representation and semantic processing are sensitive to the subgroup structure governing the sequence in these studies. The results thus suggest that events are like categories in that their elements form clusters in a representational similarity space.

COGNITIVE AND NEUROANATOMICAL SUBSTRATES OF ACTION EVENTS Laurel Buxbaum[1]; [1]Moss Rehabilitation Research Institute — Recent neuroimaging, eyetracking, and behavioral evidence from our laboratory has improved our understanding of three major aspects of action event processing. First, these data reveal that the representational structure of action events includes a number of related but separable components. For instance, neuropsychological and lesion-overlap studies suggest that representations of the sensorimotor aspects of action events (ie, movements of the body) in a left posterior temporal-parietal network may be dissociated both behaviorally and neuroanatomically from representations of overarching action goals, mediated primarily by bilateral prefrontal systems. Second, although living things appear to be represented at least in part with reference to taxomomic features computed by left middle and anterior temporal regions, manipulable objects may be preferentially represented within a left posterior temporal and inferior parietal system that captures their thematic relationships to other objects — specifically, to objects that fill complementary sensorimotor and/or spatial roles in events. Finally, the data indicate that semantic representations of manipulable objects are dynamic entities in which the salience of different semantic features varies according to an object's thematic role in a given event. This sensitivity to event context substantially impacts an object's perceived similarity to other objects, as assessed by the degree to which the objects compete for control of attention and behavior. Together, these data suggest that representations of objects are intimately intertwined with knowledge about the events in which they participate, with important consequences for both healthy behavior and disorders of action in brain-lesioned patients.



Slide Session 1

ATTENTION AND EXECUTIVE FUNCTIONS

Saturday, March 31, 1:00 - 3:00 pm, Grand Ballroom

Chair: Clayton Curtis

Speakers: Christopher T. Smith, Gregory Samanez-Larkin, Heleen Slagter, Sara Langworthy, Bo-Cheng Kuo, Lawrence Appelbaum, Michael Cole, Angus MacDonald III

ABSTRACTS

INTERACTING EFFECTS OF GENETIC POLYMORPHISMS REGULATING DOPAMINE SIGNALING IN THE FRONTAL CORTEX ON ACCURATE TARGET DETECTION UNDER HIGH WORKING MEMORY LOAD (GSA WINNER) Christopher T. Smith[1], Charlotte A. Boettiger[1]; [1]University of North Carolina at Chapel Hill — Frontal-dependent task performance is typically modulated by dopamine (DA) according to an inverted-U pattern, whereby intermediate levels of DA signaling optimizes performance. Numerous studies implicate trait differences in DA signaling based on differences in the Catechol-O-methyltransferase (COMT) gene in executive function task performance. However, little work has investigated genetic variations in DA signaling downstream from COMT. One candidate is the Dopamine- and cAMP-regulated phosphoprotein of molecular weight 32 kDa (DARPP-32), which mediates signaling through the DA D1 receptor, the dominant DA receptor in the frontal cortex. Using an n-back task, we used signal detection theory to measure performance in a healthy adult population (n=92) genotyped for single nucleotide polymorphisms in the COMT (rs 4680) and DARPP-32 (rs 907094) genes. Correct target detection (hits), and false alarms were used to calculate d' measures for each working memory load. At the highest load (3-back) only we observed a significant COMT×DARPP-32 interaction ($F(1, 88)=5.792$, $p=0.018$) such that the DARPP-32 AA genotype enhanced target detection in COMT ValVal individuals (d'=1.17±0.19 versus 0.72±0.11 in DARPP-32 G carriers) but impaired target detection in COMT Met carriers (d'=0.73±0.19 versus 1.06±0.13 in DARPP-32 G carriers). These findings suggest that enhanced dopaminergic signaling via the DARPP-32 A allele aids target detection in individuals with presumed low frontal DA (COMTVal/Val) but impairs target detection in those with putatively higher frontal DA levels (COMT Met-carriers). Moreover, they support an inverted-U model with intermediate levels of DA signaling optimizing performance on tasks requiring updating and maintenance of mental representations in working memory.

A THALAMOCORTICOSTRIATAL DOPAMINE CIRCUIT FOR PSYCHOSTIMULANT-ENHANCED HUMAN COGNITIVE FLEXIBILITY (PFA WINNER) Gregory Samanez-Larkin[1], Joshua Buckholtz[2], Robert Kessler[1], David Zald[1]; [1]Vanderbilt University, [2]Harvard University — Everyday life demands continuous flexibility in thought and behavior. Here we examined whether individual differences in dopamine function are related to variability in the effects of amphetamine on one aspect of flexibility – task switching. Forty healthy subjects performed a task-switching paradigm following placebo and oral amphetamine administration. [18F]fallypride was used to measure D2/D3 baseline receptor availability and amphetamine-stimulated dopamine release. The majority of the subjects showed amphetamine-induced benefits through reductions in switch costs. However, such benefits were variable. Individuals with higher baseline thalamocortical receptor availability and striatal dopamine release showed greater reductions in switch costs following amphetamine than individuals with lower levels. The relationship between thalamocortical receptors and stimulant-enhanced flexibility is partially mediated by striatal dopamine release. These data indicate that the impact of the psychostimulant on cognitive flexibility is influenced by the status of dopamine within a thalamocorticostriatal network. Given that the effects of amphetamine on task switching are variable across subjects, there may be utility in being able to predict which individuals are most likely to benefit from psychostimulants. Beyond demonstrating a link between this dopaminergic network and the enhancement in task switching, these neural measures accounted for unique variance in predicting the psychostimulant-induced cognitive enhancement. This raises the possibility of using these neural measures to predict stimulant treatment effectiveness. The present results also suggest that there may be measurable aspects of variability in the dopamine system that predispose certain individuals to benefit from and hence use (or even abuse) psychostimulants for cognitive enhancement.

A ROLE FOR STRIATAL DOPAMINE IN MEDIATING THE ATTENTIONAL BLINK: FUNCTIONAL IMPLICATIONS Heleen Slagter[1], Rachel Tomer[2], Brad Christian[3], Andrew Fox[3], Lorenza Colzato[4], Carlye King[3], Dhanabalan Murali[3], Richard Davidson[3]; [1]University of Amsterdam, [2]University of Haifa, [3]University of Wisconsin-Madison, [4]Leiden University — The attentional blink (AB) reflects a deficit in perceiving the second of two meaningful events presented in close temporal succession in a rapid stream of distracter events. Given the known role of striatal dopamine in regulating the contents of working memory and hence, conscious perception, this study tested the hypothesis that striatal dopamine plays a mediating role in the AB. Subjects performed an AB task and their basal level of D2-like receptor binding was measured using positron emission tomography (PET) and the radioligand [F- 18]fallypride. As predicted, individual differences analyses showed that greater D2-like receptor binding in the dorsal striatum was associated with a larger AB. This finding provides critical support for the idea that striatal dopaminergic neurotransmission, and hence, mechanisms important for dynamically regulating the contents of working memory, play an important role in mediating the AB. Specifically, given the known role of the striatal D2 pathway in preventing gating of irrelevant information into working memory, this finding provides neural evidence for the idea that the AB is – at least in part – determined by mechanisms involved in suppressing irrelevant information. A challenge for current computational and theoretical accounts of the AB lies in connecting more directly with these and other neurobiological data.

THE IMPACT OF EXECUTIVE FUNCTION ABILITY ON NEURAL PROCESSING OF REWARD INFORMATION: AN FMRI STUDY. Sara Langworthy[1], Kathleen Thomas[1]; [1]University of Minnesota — Previous research has not extensively explored the intersection of executive function (EF) and reward processing across development in order to discern how these processes might be linked in underlying dopamine-rich neural fronto-striatal circuits in the brain. Functional Magnetic Resonance Imaging (fMRI) and Positron Emission Tomography (PET) scans show differences in activation patterns in between individuals with ADHD and typically developing controls including lower levels of activation in fronto-striatal areas that are usually highly activated for high magnitude rewards. In this study, we examined the differences in fronto-striatal activation in response to rewarding stimuli for children grouped by Low and High levels of EF ability. Twenty-four children completed the Monetary Incentive Delay task during an fMRI scan. The High and Low EF groups showed different patterns of activation for large versus small rewards in the orbitofrontal cortex, putamen, and caudate. The High EF group showed greater activation for large over small gain trials in the right orbitofrontal cortex, left putamen, and the posterior caudate. The Low EF group showed greater activation for small over large gain trials in left orbitofrontal cortex, and left posterior caudate. Previous research has found less activation for reward conditions in fronto-stratial regions in individuals with ADHD. The Low EF group may be exhibiting altered activation similar to individuals with ADHD perhaps indicative of reward insensitivity.

ATTENTION BIASES VISUAL ACTIVITY IN WORKING MEMORY Bo-Cheng Kuo[1,2], Mark Stokes[1], Alexandra M. Murray[1], Anna Christina Nobre[1]; [1]University of Oxford, [2]National Chengchi University, Taipei, Taiwan — Recent studies have shown that directing attention to relevant items maintained in working memory can improve performance. However, the neural mechanisms mediating this behavioral effect are still unclear. In this fMRI study, we investigated whether attention modulates visual activity during working memory maintenance. Participants (N = 12) performed a delayed-response task in which attention was manipulated during the retention interval. In each trial, a memory array of four peripheral items was initially presented for 200 msec, followed by a single centrally presented cue (retro-cue, 200 msec) after a 2-sec interval. Participants were instructed to direct attention to the item in working memory indicted by the retro-cue. After an 8-sec interval, a probe array of four peripherally located items was presented for 200 msec. All items in the probe array were the same as those in the memory array; however, two items always swapped location. On 50% of trials, this swap included the cued item. Participants responded "match" or "no-match", according to whether the item at the cued location was the same, or different, as the corresponding item from the previous memory array. We analysed maintenance-related activity in retinotopically defined regions of interest in posterior visual cortex. Our results demonstrate that orienting attention to the location of the cued item modulates maintenance-related activity. The response in a given retinotopic region was significantly increased when that location was cued relative to when it was uncued. We suggest that modulation of visual activity contributes to the mechanisms of attentional control over working-memory maintenance.

PROACTIVE AND REACTIVE COGNITIVE CONTROL MECHANISMS IN THE HUMAN BRAIN Lawrence Appelbaum[1], Carsten Boehler[2], Marty Woldorff[1]; [1]Duke University, [2]Gent University — In the present research we exploit the high-temporal resolution of EEG to examine the neural mechanisms underlying the flexible regulation of cognitive control that unfolds over different timescales. We measured behavioral and neural effects of color-word incongruency as different groups of participants (n=84) performed four different versions of the Stroop and Reverse Stroop tasks in which the relative timing (SOA) of the color and word features were varied from trial-to-trial and thereby varied the need for reactive control processes. Across these tasks, we also altered the proportion of congruent-to-incongruent trials (50/50% versus 80/20%) and the temporal predictability of the SOAs (random versus constant) to determine how these contexts ramified into differing levels of proactive/strategic control. Across tasks, when the SOA arrangement was random we observed the greatest incongruency effects when the task-irrelevant stimulus preceded the target, whereas with predictable SOAs the incongruency effects were largest with simultaneous occurrence. In line with automaticity theories of word reading, incongruency effects were reduced nearly 50% for word-identification, but these completely recovered when incongruent trials appeared only infrequently. Across all conditions the amplitude of the negative-polarity, incongruency-related ERP wave (NINC) closely paralleled the RT incongruency effects, indicating this component is sensitive to the overall level of stimulus conflict, whereas the amplitude of the late positive ERP component (LPC) inversely tracked the overall level of top-down control, suggesting a possible compensatory role due to reduced proactive control. The present findings demonstrate distinct control mechanisms that unfold over time in response to conflict in differing contexts.

IDENTIFYING FLEXIBLE HUBS: A NOVEL MECHANISM FOR FLEXIBLE COGNITIVE CONTROL Michael Cole[1], Joset Etzel[1], Todd Braver[1]; [1]Washington University in St. Louis — The rapid flexibility of the human brain is impressive. For instance, we recently demonstrated that humans are able to learn novel tasks in seconds. The common proficiency of healthy adults at using complex new technologies (e.g., computers, 'smart' phones) further demonstrates the brain's ability to reconfigure to a variety of possible arbitrary states. We postulate that such flexible cognitive control arises in part from what we term 'flexible hubs' – highly connected regions that can flexibly change their connectivity patterns depending on task demands. We present a novel graph theoretic method for identifying putative flexible hubs – globally reconfigured connectivity (GRC). GRC uses functional connectivity MRI to identify regions with the most brain-wide connectivity changes among tasks. We used GRC to identify regions showing high connectivity variation across 64 unique tasks. One such putative flexible hub was a recently identified portion of dorsolateral prefrontal cortex (DLPFC) whose global connectivity at rest predicts general fluid intelligence. This finding suggests high DLPFC global connectivity at rest may allow for a large number of potential connectivity patterns to be used during tasks – increasing the flexibility of this region's connectivity and of the ability to implement cognitive control according to a variety of potential task demands.

COMPARISON OF TASK- AND REST-RELATED INTRINSIC CONNECTIVITY NETWORKS FOR THE STUDY OF INDIVIDUAL DIFFERENCES IN COGNITIVE CONTROL Angus MacDonald III[1,2], Krista Wisner[1], Andrew Poppe[1], Edward Patzelt[1]; [1]University of Minnesota, Department of Psychology, [2]University of Minnesota, Department of Psychiatry — Functional connectivity analyses are increasingly used for understanding fundamental aspects of brain network dynamics. Recently, data-driven techniques such as independent components analysis have been used to extract a number of intrinsic connectivity networks (ICNs) associated with cognitive control while the brain is at rest. The current analyses compared the neurometric properties of cognitive control networks extracted from resting state data to those same networks extracted when performing a cognitive control task. Study 1 evaluated 27 participants twice 9 months apart during 6 minutes of resting data. Study 2 evaluated 36 participants twice 3 weeks apart while performing a goal maintenance task. Multiple subject entry orders were used with FSL's MELODIC and a meta-level independent component analyses (ICA) resulted in a robust ICN structure independently for each group at each time point. Dual-regression and resampling was used to test the statistical significance of 5 ICNs identified through BrainMap meta-analyses (Laird, et al., JCN, 2011): a cognitive control network (bilateral BAs 6, 8/9), left and right executive networks (44/45 and 22/39/40), a visuospatial processing and reasoning network (bilateral BAs 46, 7), and a cognition and emotion/interoception network (bilateral BAs 13/16, 24). Brainwise correlations, overlap coefficients and intraclass correlations provided converging metrics of the ICNs retest reliability. Both resting state and task data overlapped with a priori

ICNs; Although reliability coefficients varied across networks, the greater length of scanning and the shorter retest interval for the task-related data resulted in only marginally different neurometrics for evaluating individual differences in cognitive control network connectivity.

Slide Session 2

OPEN PAPER SESSION

Saturday, March 31, 3:00 - 4:15 pm, Grand Ballroom

Chair: R. Alison Adcock

Speakers: Elisabetta Ladavas, Brian Haas, Michael Grubb, Megan Boudewyn, Alan Anticevic

ABSTRACTS

EMOTIONAL MODULATION OF VISUAL REMAPPING OF TOUCH Elisabetta Ladavas[1], Cardini Flavia[1], Bertini Caterina[1], Serino Andrea[1]; [1]University of Bologna — The perception of tactile stimuli on the face is modulated if subjects concurrently observe a face being touched; this effect is termed "Visual Remapping of Touch", or the VRT effect. Given the high social value of this mechanism, we investigated whether it might be modulated by specific key information processed in face-to-face interactions: facial emotional expression. In two separate experiments participants received tactile stimuli, near the perceptual threshold, either on their right, left or both cheeks. Concurrently, they watched several blocks of movies depicting a face with a neutral, happy or fearful expression that was touched or just approached by human fingers (Experiment 1). Participants were asked to distinguish between felt, unilateral and bilateral, tactile stimulation. Tactile perception was enhanced when viewing touch towards a fearful face compared to viewing touch towards the other two expressions. In order to test whether this result can be generalized to other negative emotions or whether it is a fear-specific effect, we ran a second experiment where participants watched movies of faces - touched or approached by fingers - with either a fearful or an angry expression (Experiment 2). In line with the first experiment, tactile perception was enhanced when subjects viewed touch towards a fearful face and not towards an angry face. Results of the present experiments are interpreted in light of different mechanisms underlying different emotions recognition, with a specific involvement of the somatosensory system when viewing a fearful expression and a resulting fear-specific modulation of the VRT effect.

GENETIC EFFECTS ON THE MICRO-STRUCTURE OF THE AMYGDALA, FUSIFORM, HIPPOCAMPUS IN HUMANS Brian Haas[1,2], Naama Barnea-Goraly[1], Kristen Sheau[1], Bun Yamagata[1], Shruti Ullas[3], Reiss Allan[1]; [1]Center for Interdisciplinary Brain Sciences Research (CIBSR), Stanford University School of Medicine, [2]Department of Psychology, University of Georgia, [3]Department of Psychology, University of California Los Angeles (UCLA) — Williams syndrome (WS) is caused by a contiguous deletion of approximately 26 genes on chromosome 7q11.23. This condition is associated with a compelling social-cognitive profile characterized by deficits in emotion and face recognition and with an abnormally heightened drive toward social engagement. Investigating WS provides an excellent opportunity to elucidate the pathway between genes, the brain and social cognitive function in humans. This study was designed to investigate the influence of the WS genetic deletion on the microstructure within the social-cognitive brain network including the amygdala, fusiform gyrus and hippocampus and related white matter pathways by collecting Diffusion Tensor Imaging (DTI) data from children with WS and typically developing (TD) children. We performed two complimentary analyses. Specifically, Atlas Based region of interest analysis was performed to investigate microstructure integrity within the amygdala, fusiform gyrus and hippocampus. Tract Based Spatial Statistics (TBSS) was performed to investigate white matter integrity within the inferior frontal occipital (IFO) and uncinate fasciculus (UF) white-matter tracts. Results indicated that the WS group relative to TD controls exhibited greater fractional anisotropy (FA) within the bilateral amygdala and fusiform gyrus, left hippocampus and the right IFO and UF. These data provide evidence that genetic deletion in WS is associated with microstructural changes within a network of brain regions and white-matter pathways important for social cognition. Additionally, this study provides support for the use DTI as a tool to elucidate microstructural alterations within the social-cognitive brain.

A NEURAL SIGNATURE OF COVERT DISENGAGEMENT DURING MOVIE VIEWING Michael Grubb[1], Pascal Wallisch[1], Uri Hasson[2], David J. Heeger[1]; [1]New York University, [2]Princeton University — Engaging with an external stimulus is associated with decreased activity in a network of brain areas called the default network, or intrinsic system. Conversely, increased activity in the intrinsic system has been found to coincide with moments of "inattention" to experimental tasks. This study tested the hypothesis that activity in the intrinsic system can be used as a marker for covert disengagement from a highly naturalistic task: movie-viewing. Brain activity was measured with functional magnetic resonance imaging (fMRI) while participants watched a commercially produced film. The degree of engagement with the film, as indexed by post-viewing behavioral appraisals, was predicted to vary between participants. Fluctuations in intrinsic–system activity during movie-viewing might reflect such individual differences, with greater response modulation being predictive of a less favorable appraisal of the film. Despite no evidence for differences in eye movements during movie-viewing, individual differences in intrinsic–system activity were indeed predictive of movie appraisal ratings: lower ratings were associated with larger amplitude modulations in intrinsic-system activity and with larger covariance in activity between intrinsic-system brain areas.

CONTEXT, CONTROL AND COMPREHENSION IN SCHIZOPHRENIA: GETTING THE GLOBAL MESSAGE DEPENDS ON LOCAL SEMANTIC PRIMING Megan Boudewyn[1], Tamara Swaab[1], Cameron Carter[1]; [1]University of California, Davis — Individuals with schizophrenia have clear language impairments, but the relationship between these deficits and impaired cognition is unknown. Previous studies of language processing in schizophrenia have reported increased effects of lexical priming ("hyper-priming") as well as difficulties processing linguistic context. Studies of cognitive deficits in schizophrenia have shown impairments in the controlled maintenance of contextual information and the ability to overcome conflict. This has been related to dysfunctions of the dorsolateral prefrontal cortex and the anterior cingulate, areas of the brain that may also be important for establishing a coherent discourse representation. In our study, participants listened to three-sentence passages in which we manipulated global discourse coherence and local priming. The critical final word in the last sentence of each story was globally coherent or incoherent and locally primed or unprimed; e.g., "Luckily Ben had picked up some salt and pepper/basil", preceded either by a context in which Ben was preparing marinara sauce, or dealing with an icy walkway. In contrast to controls, schizophrenia patients: 1) only showed N400 effects of discourse coherence when a locally associated word preceded the critical final word, indicating that patients constructed globally coherent discourse representations only when there was support from the local context; 2) only showed N400 effects of local priming in globally coherent contexts, indicating that patients had difficulties overcoming conflict between the activated meaning of the critical word and the meaning representation of the overall discourse. These results suggest that deficits in cognitive control affect language comprehension in schizophrenia.

UNDERSTANDING WORKING MEMORY FUNCTION THROUGH PSYCHOPATHOLOGY: FOCUS ON SCHIZOPHRENIA AND COMPUTATIONAL MODELING Alan Anticevic[1], John Murray[1], Philip Corlett[1], Xiao-Jing Wang[1], Deanna Barch[2], John Krystal[1]; [1]Yale University, [2]Washington University in St. Louis — Although basic cognitive neuroscience has made major strides, understanding of working memory

(WM) remains incomplete. One way towards this goal involves examining clinical populations with breakdowns in these very functions. This is crucial, not only from a basic science perspective, but also for developing targeted treatments of WM deficits present in clinical conditions–namely schizophrenia (SCZ). Optimal WM function critically depends on resisting interference; however, neural mechanisms of WM filtering and its breakdowns are have not been elucidated. We present a clinical study, which informs upon our basic understanding of WM filtering mechanisms. First, we tested the hypothesis that SCZ is associated with a general inability to filter distraction versus a more specific deficit in the ability to filter affectively salient distraction. 28 patients and 24 matched controls underwent fMRI at 3T. Subjects performed a delayed-response WM task faced with affectively negative, neutral or task-related interference. Results suggest that, unlike healthy individuals, patients fail to deploy dorsolateral prefrontal cortex activity, irrespective of distracter type, pointing to a general filtering deficit and the critical role of this region in resisting interference. Next, we focus on mechanistically understanding WM filtering. To this end, we employ a biophysically grounded computational model. Within this model we implement a leading hypothesis of SCZ neuropathology–namely cortical dysinhibition–and examine model performance under distraction. Lastly, we discuss aligning computational models, grounded in animal physiology, with cognitive probes of WM, which confers the exciting possibility for understanding of WM function from cells, to circuits, to behavior.

Slide Session 3

PERCEPTION

Sunday, April 1, 10:00 am - 12:00 pm, Red Lacquer Room

Chair: Alumit Ishai

Speakers: Alexander Clarke, Andrew Connolly, Karin James, Toralf Neuling, Julian Keil, David Brang, Jascha Swisher, Joshua Carp

ABSTRACTS

PREDICTING THE TIME-VARYING NEURAL REPRESENTATION OF MEANINGFUL OBJECTS USING SEMANTIC FEATURE-BASED STATISTICS Alexander Clarke[1], Barry Devereux[1], Billi Randall[1], Lorraine K. Tyler[1]; [1]University of Cambridge — The neural representation of meaningful objects emerges over time with visual effects before 100 ms in visual cortex and semantics after 150 ms along the ventral stream. Feature-based semantic accounts argue that statistical measures derived from semantic features capture meaningful object processing, yet it's unclear: 1) whether feature-based models account for neural activity, 2) at what time-point this information emerges, and 3) whether this information is behaviourally relevant. Here we test whether perceptual or feature-based measures shape time-varying neural activity recorded with MEG. Subjects named pictures at a basic-level during MEG recording. Multivariate multiple linear regression models were trained using perceptual and semantic measures to predict MEG data across time for novel concepts, before assessing classification accuracy with leave-two-out cross-validation. Source localisation of training weights determined the regions underpinning classification. For behaviour, multiple linear regression was performed between naming latencies and perceptual and semantic variables, while linear regression was applied between MEG signals and naming latencies. We find a model trained on perceptual measures classified novel concepts significantly above chance beginning 80 ms after picture onset that was driven by the visual cortex. A model trained with feature-based measures successfully classified concepts after 160 ms that localised to anterior temporal and posterior fusiform. Further, MEG data correlated with naming latencies after 160 ms showing this activity is behaviourally relevant. In conclusion, time-varying neural representations of meaningful objects are initially shaped by perceptual parameters before fine-grained conceptual processes after 150 ms in the anterior temporal and posterior fusiform that support behaviour.

ANIMACY CONTINUUM EVIDENT IN VISUAL REPRESENTATIONS OF BIOLOGICAL CLASSES Andrew Connolly[1], James Haxby[1,2]; [1]Dartmouth College, [2]University of Trento — Neuroimaging of the human visual cortex has revealed highly reproducible findings in the ventral pathway for animate versus inanimate objects. Far less is known about representational structure within the domain of animate categories, for example how different animals are represented. Using fMRI we recorded brain activity associated with viewing 17 different animal species across two experiments. In experiment 1 (N=12), there were six species with 2 each from the superordinate categories primates, birds, and bugs, and in experiment 2 (N=10) there were 12 species with 4 each from mammals, reptiles, and bugs. Using multi-variate similarity structure analysis, we found that representational structure in lateral occipital complex (LOC) was highly reproducible across subjects with average pairwise correlation between subjects of r = .94 (experiment 1) and r = .86 (experiment 2). Multidimensional scaling revealed primary dimensions of representation spanning primates to bugs (experiment 1) and mammals to bugs (experiment 2). Activation maps reveal greater activity for mammals than for bugs in lateral fusiform and pSTS, and greater activity for bugs than for mammals in medial fusiform and lateral inferior temporal cortex. The mammals, which are both subjectively and biologically closer to humans, produced patterns of activity in object vision cortex that is typical of animate objects, while bugs, which are subjectively and biologically distant from humans produced patterns similar to those for inanimate objects. These findings suggest that animal species fall along a continuum in representational space that is predictable by the degree of perceived animacy.

THE NEURAL CORRELATES OF OBJECT EXPERTISE IN THE YOUNG CHILD Karin James[1], Thomas James[1], Shelley Swain[1]; [1]Indiana Univeristy — During development, some children develop extreme interests with a particular category of objects. It is likely that this experience plays a role in the organization and development of children's brains. In children and adults, expertise-related influences on brain organization has mostly been studied with respect to human faces; adult-like face expertise develops around 7 or 8 years old. However, the influence of non-face object expertise on brain development has not been investigated systematically, even though some children develop expertise with other categories before faces. Here, we address this issue by recruiting and assessing expertise in a group of 8-10 year old children who professed an unusually intense interest in Pokemon cards and games. BOLD fMRI was measured in these children, a control group of children, and a group of adult Pokemon experts. Subjects were shown intact and scrambled versions of human faces and Pokemon. Results demonstrated that expert children showed significantly greater activation in the fusiform gyrus, bilaterally, with Pokemon than with faces or with scrambled stimuli. In contrast, control children showed differences between intact and scrambled stimuli, but greater activation for human faces than Pokemon. Adult experts showed a similar pattern to child experts. The results suggest that the putative face-selective brain network in adults develops based on experience with multiple categories of objects (both faces and non-faces). Such findings suggest that these brain regions are part of a domain-general system for processing objects of expertise that is not specific to human faces.

OSCILLATORY PHASE SHAPES AUDITORY PERCEPTION Toralf Neuling[1], Stefan Rach[1], Christoph Herrmann[1]; [1]Carl von Ossietzky University Oldenburg, Germany — In the current study we provide compelling evidence to answer the long-standing question whether perception is continuous or periodic. Spontaneous brain oscillations are assumed to be the underlying mechanism of periodic perception. Depending on the phase angle of the oscillations, an identical stimulus results in different perceptual outcomes. Past results, however, can only account for a correlation of perception with the phase of the ongoing EEG oscillations. Therefore, it is

desirable to demonstrate a causal relation between phase and perception. One way to address this question is to entrain spontaneous brain oscillation by applying an external oscillation and then demonstrate behavioral consequences of this oscillation. Therefore, we conducted an auditory detection experiment with concurrent electroecephalography (EEG) and simultaneously applied oscillating transcranial direct current stimulation at 10 Hz (alpha-tDCS). Our approach revealed that detection thresholds were dependent on the phase of the oscillation that was elicited by alpha-tDCS. This behavioral effect was accompanied by an electrophysiological effect: alpha-power was enhanced after alpha-tDCS as compared to a pre-stimulation period. By showing a causal relation between phase and perception, our results extend findings of previous studies that were only able to demonstrate a correlation. We found that manipulation of the phase resulted in different detection thresholds, which supports the notion that perception can be periodically modulated by oscillatory processes. This demonstrates that tDCS can serve as a tool in neuroscience to extend the knowledge of the functional significance of brain oscillations.

SINGLE TRIAL PRE-STIMULUS BETA-BAND PHASE INFLUENCES AUDIOVISUAL INTEGRATION (GSA WINNER) Julian Keil[1], Nadia Müller[1,2], Thomas Hartmann[1], Nathan Weisz[1,2]; [1]University of Konstanz, [2]Zukunftskolleg University of Konstanz — The question whether multisensory information integration requires specific pre-stimulus brain states has recently come into focus. The sound induced flash illusion is an example for the influence of auditory information on visual perception. It consists of the perception of two visual stimuli upon the presentation of only a single visual stimulus accompanied by two auditory stimuli. We used magnetoencephalography (MEG) to assess the influence of ongoing pre-stimulus oscillatory phase and power on varying perception of invariant stimuli. We compared cortical activity for trials in which subjects perceived two visual stimuli (i.e. an illusion) with trials in which subjects perceived only one visual stimulus (i.e. no illusion), thus keeping the stimulation fixed. Subjects perceived the illusion in ~50% of trials. In trials containing an illusion, we found stronger pre-stimulus (-.5 to -. 1 s) beta band (13-21 Hz) power in a left temporal sensor cluster and localized it to left middle temporal gyrus (BA39). In illusion trials, this area was stronger phase locked to the left auditory area BA21 and phase difference between these areas predicted subsequent illusory perception on single trial level. In a second study, single-pulse pre-stimulus TMS to left BA39 could modulate the occurrence of the illusion. Our results support recent reports on the influence of brain states prior to stimulation on subsequent perception. We suggest that ongoing pre-stimulus fluctuations of oscillatory activity in multimodal brain regions as well as its varying connection to primary sensory areas form predispositions whether different sensory streams will be integrated or not.

ENHANCED MULTISENSORY INTEGRATION RELATES TO INCREASED PARIETAL WHITE MATTER CONNECTIVITY David Brang[1], Zack Taich[1], Steven A Hillyard[1], Vilayanur S Ramachandran[1]; [1]University of California, San Diego — Our senses interact in daily life through multisensory integration, facilitating perceptual processes and behavioral responses. Multisensory processing varies greatly between healthy individuals and in particular across the lifespan. Indeed, research suggests that multisensory integration may increase from adolescence through late-adulthood regardless of the well-documented decline in connectivity that is associated with aging, making any model of multisensory processing particularly complex. Several potential mechanisms exist to explain how information from distinct sensory modalities integrates into a unified percept, including multisensory regions in the parietal lobe, direct communication between the individual senses, multisensory areas in subcortical structures including the superior colliculus, or even through multisensory responses within the primary sensory systems (e.g. neurons in visual cortex that respond to auditory stimuli). Each of these models of multisensory integration, however, predicts distinct patterns of anatomical connectivity in the brain. Here we provide the first test of these models using diffusion tensor imaging (DTI), by examining individual difference measures of anatomical connectivity and multisensory integration (using a simple speeded reaction time paradigm). Results reveal that a faster response to a bimodal (as compared with a unimodal) stimulus positively correlates with anatomical connectivity in the intraparietal sulcus highlighting the importance of connections in this region. This finding suggests that multisensory information is related to multisensory regions in the parietal lobe through indirect anatomical connections, as opposed to being integrated directly between associated modalities.

VARIABILITY IN SIMPLE REACTION TIMES CORRELATES WITH BOLD ONSET LATENCY IN MOTOR CORTEX (PFA WINNER) Jascha Swisher[1], Allen Newton[1], Robert Barry[1], John Gore[1], Frank Tong[1]; [1]Vanderbilt University — Reaction time (RT) measurements lie at the core of many classic findings in cognitive psychology. The ability to observe similar changes in the timing of the BOLD response may help in associating such effects with activity in particular regions of the brain. Using time-resolved (176ms) whole-brain fMRI at 7 Tesla, here we show that trial-to-trial variability in response times in a simple reaction time paradigm is reflected in the latency of motor cortex activation. Participants pressed a button as quickly as possible upon presentation of a checkerboard pattern, which occurred at random exponentially-distributed intervals. Trials were binned into quartiles by RT, and separate estimates of the time to onset of the hemodynamic response (HDR) were obtained for each quartile. A highly significant increase in onset latencies with longer RTs was observed in motor cortex, while visual cortex latency also increased significantly with RT. A difference in the slope of the relationship between HDR latency and RT across areas approached significance; a linear model fit to the data predicts that a 10ms increase in RT would be reflected in a 10ms delay in the onset of motor cortex activity, but only a 5ms delay in visual activity. Under the assumption that cortical areas represent serial processing stages with non-independent delays, this difference in slopes suggests that processing in visual cortex occurred before that in motor areas. These results show promise for fMRI's utility in similar studies of mental chronometry.

ESTIMATING THE ANALYTIC FLEXIBILITY OF FUNCTIONAL NEUROIMAGING: IMPLICATIONS FOR UNCERTAINTY AND BIAS IN COGNITIVE NEUROSCIENCE Joshua Carp[1]; [1]University of Michigan — How vulnerable is the field of cognitive neuroscience to bias? According to a recent mathematical model, the potential for scientific bias increases with the flexibility of analytic modes. In other words, the greater the range of acceptable analysis strategies, the greater the likelihood that published research findings are false. Thus, the present study sought to empirically estimate the analytic flexibility of fMRI research. We identified five pre-processing decisions and five modeling decisions for which two or more analysis strategies are commonly used in the research literature. By crossing each of these strategies and decisions, we identified 4,608 unique analysis pipelines. Next, we applied each of these pipelines to a previously published fMRI study of novelty detection in an auditory oddball task. We found that activation estimates were highly dependent on methodological decisions: contrasts that yielded significant positive activation under one pipeline were associated with non-significant positive activation or even with negative activation under other pipelines. Some analysis decisions contributed more to this variability more than others, and each decision exerted a unique pattern of variability across the brain. The effects of a given decision also varied across contrasts, subjects, and other analysis parameters. In sum, we found considerable quantitative and qualitative variability across analysis pipelines, suggesting that the results of cognitive neuroimaging experiments may be more uncertain than they seem. Indeed, given a supercomputer, a sufficiently motivated analyst might observe almost any imaginable pattern of results.

Slide Session 4

THINKING AND DECISION MAKING

Monday, April 2, 10:00 am - 12:00 pm, Red Lacquer Room

Chair: Kalinia Christoff

Speakers: Aysha Keisler, Daniel Hawes, Joseph Kim, G Elliott Wimmer, Robert Emerson, Perrine Ruby, Mathieu d'Acremont, Eva Telzer

ABSTRACTS

COST AND REWARD MODULATION OF CORTICAL INHIBITION Aysha Keisler[1], Eric Mooshagian[1], Reza Shadmehr[2], Eric Wassermann[1]; [1]National Institutes of Health, [2]Johns Hopkins University — The cortico-striatal system is known to be involved in reward response. While considerable work has elucidated midbrain reward mechanisms, we know little about the cortical component of this loop. Previous work shows that cortical inhibition, as assessed by transcranial magnetic stimulation, can be modulated by reward state. Thus, cortical inhibition may provide a window into the state of the reward system. Here, we assess how reward is discounted by costs in humans, as measured by changes in cortical inhibition. Monetary reward was given for correct responses on a visual discrimination task. Participants responded by making either a low-effort or a high-effort motor movement with the left hand. In this way, we could vary cost and reward independently to manipulate 'discounted reward', or the difference between the monetary value given on the trial (reward) and the effort exerted to obtain the reward (cost). TMS was applied to M1of the left hemisphere after reward onset and motor evoked potentials were recorded from the right hand to measure cortical inhibition as a function of discounted reward. As in previous studies, we found a main effect of (undiscounted) reward on cortical inhibition. Further, we found that reward is indeed discounted by cost, as inhibition is greater in the low-effort condition than the high-effort condition, for a given reward. The results suggest that reward value is not absolute; rather, rewarding feedback is appraised relative to the cost of obtaining it.

THE CORRELATION OF NEURAL ACTIVITY AND PERSONALITY TRAITS IN RESPONSE TO MONETARY GAINS AND LOSSES Daniel Hawes[1], Colin DeYoung[1], Jeremy Gray[2], Aldo Rustichini[1]; [1]University of Minnesota, [2]Yale University — To integrate decision theory with personality theory, we investigate the relation between personality traits and neural responses to anticipated and realized gains and losses after choice. In a fMRI experiment (N=114), subjects are asked to guess whether a computer-generated number between 1 and 6 falls into the lower or upper range of the interval. Correct guesses are rewarded, while incorrect guesses are penalized. We modify a similar design used by Delgado et al. in Journal of Neurophysiology, 2000, by informing subjects whether a trial is going to be consequential (guesses are rewarded/penalized) or neutral (no payment). In addition to fMRI data, we gather information on personality traits, cognitive skills (IQ), demographic variables and social indicators. We identify several cortical and subcortical regions with strong differential activation to consequential versus neutral trials. These include Striatum, Thalamus, Anterior Cingulate, medial Prefrontal Cortex, and Insula. In these regions neural responses to revelation of a consequential trial correlate significantly with individual difference measures: For example, thalamic response correlates positively with Sensation Seeking and negatively with Impulsive Urgency. A matching pattern is found bilaterally for Caudate regions. In cortical regions, consequential trials are followed by neural responses that correlate with traits of Premeditation and IQ. Focusing on the Striatum, we replicate the neural response pattern to gains and losses, previously identified in Delgado et al. We find that components of the gain/loss response correlate with subject's scores on the behavioral avoidance (or inhibition) scale (BIS), and the Big 5 traits of Neuroticism and Openness.

ORBITOFRONTAL CORTEX LESIONS DISRUPT ADAPTATION OF CHOICE-BEHAVIOR TO VARYING AFFECTIVE CONTEXT IN ECONOMIC DECISION-MAKING Joseph Kim[1], Eunice Yang[1], Lindsey Overhalser[1], Lucas Wonderley[1], Maureen McHugo[1], Mildred Dukic[1], Rebecca Ray[2], David Zald[1]; [1]Vanderbilt University, [2]University of Wisconsin - Madison — In the current study, we sought to examine the effect of orbitofrontal cortex (OFC) lesions on framing biases associated with economic decision-making. Previous neuroimaging studies have identified the OFC as a region involved in decision-making. Still unclear is however, to what extent OFC lesions in humans influence economic heuristics understood to vary according to the context in which the alternatives are framed. Here, we investigated economic choice-behavior of twelve OFC lesion patients using a financial decision-making task. Specifically, we examined (i) whether OFC lesions alter choice-behavior by disrupting normative processes that bias choice-preference in contrasting affective contexts (i.e., monetary reward framed as gain or loss); and (ii) whether the putative alteration in economic choice patterns reflect generalized disinhibition of choice-behavior or more specific deficits associated with sensitivity to reward magnitudes. Results indicated that patients with OFC lesions show reduction in the extent of bias against choosing financial options framed as loss (versus gain) compared to that exhibited by demographically matched controls. However in trials overall, lesion patients were no more or less likely than controls to choose the gamble option, discrediting the hypothesis that OFC lesions cause a generalized disinhibition in choice-behavior. Critically, OFC lesion patients' choice-pattern in response to offers varied in the amount of monetary reward revealed diminished sensitivity to varying reward magnitudes. By assessing the effect of OFC lesions on economic choice-behavior under contrasting affective context and varying reward magnitudes, the present study provides a more detailed examination of the OFC's contribution to reward-based decision-making.

NEURAL AND BEHAVIORAL PREDICTORS OF SUBSEQUENT MEMORY DURING REWARD LEARNING G Elliott Wimmer[1], Erin Kendall Braun[1], Daphna Shohamy[1]; [1]Columbia University — Decision making and memory are tightly related. Much recent work has investigated how people learn value based on repeated feedback. However, it is largely unknown whether ongoing reward learning influences other forms of memory, such episodic memory. Further, episodic memories formed during learning may bias later choices, yet relatively little is known about the mechanisms by which this form of memory contributes to choice. Our goal was to explore these two questions in a modified reward learning game. Participants made choices between two options (colored squares), each associated with drifting reward probabilities. Additionally, we overlaid trial-unique object pictures on each option. Participants were instructed that these objects were not part of the game. After learning, participants were given a surprise memory test for the objects. Participants exhibited significant subsequent memory for the pictures. Moreover, we found that memory formation was significantly predicted by variables associated with learning: choice, exploration, and reward. Intriguingly, overnight consolidation reversed the sign of several predictors; for example, reward shifted from a positive to a negative predictor. During reward learning, activation in the hippocampus predicted subsequent memory overall, and the beneficial effects of choice on memory were reflected in activation in object-selective cortical regions and medial PFC. Building on these memory findings, we tested whether objects incidentally presented during learning can bias subsequent choice. Results suggest that participants are biased to choose previously rewarded stimuli. This work provides initial insight into how choice may influence episodic memory and how memory may influence later choice.

EARLY MATH ACHIEVEMENT AND FUNCTIONAL CONNECTIVITY IN THE FRONTO-PARIETAL NETWORK Robert Emerson[1], Jessica Cantlon[1]; [1]University of Rochester — Here we show that functional connectivity of the intraparietal sulcus (IPS) and prefrontal cortex (PFC), measured while children view Sesame Street, predicts their performance on a

mathematics achievement test (TEMA-3; Ginsburg, 2003). Specifically, we tested 4- to 11-year-old children on a matching task during fMRI to localize a fronto-parietal network that responds more strongly during numerical matching than matching faces, words, or shapes. We then tested the functional connectivity between those regions during an independent task: free viewing of an educational video that included math topics. We found that the connectivity between frontal and parietal regions during task-independent free-viewing of educational material is predictive of children's basic number matching ability, as well as their scores on the standardized test of mathematical ability (the TEMA). The correlation between children's mathematics scores and fronto- parietal connectivity is math-specific in the sense that it is independent of children's verbal IQ scores. Moreover, a control network, selective for faces, showed no correlation with mathematics performance. We suggest that the functional intersection of these frontal and parietal regions is math-specific.

WHICH CEREBRAL ACTIVITY DIFFERENTIATES DREAMERS FROM NON-DREAMERS ? ERPS AND PET STUDIES Perrine Ruby[1,2], Olivier Bertrand[1,2], Jerome Daltrozzo[1,2], Jerome Redoute[4], Nicolas Costes[4], Alain Nicolas[3], Dominique Morlet[1,2], Jean-Baptiste Eichenlaub[1,2]; [1]Lyon Neuroscience Research Center, INSERM U1028 - CNRS UMR5292, Brain Dynamics and Cognition Team, Lyon, France, [2]University Claude Bernard Lyon 1, Lyon, France, [3]Unité d'Exploration Hypnologique, CH le Vinatier, Lyon, France, [4]CERMEP-Imagerie du Vivant, Lyon, France — Dreaming is still a mystery of human cognition. In the fifties, dreaming was associated with rapid eye movement (REM) sleep (Dement & Kleitman 1957; Sastre & Jouvet 1979) but this hypothesis which cannot explain all the characteristics of dream reports has been challenged (Solms 1997; Nir & Tononi 2010). We used event-related potentials (ERPs) and positron emission tomography (PET) during wakefulness and sleep, to measure brain activity in subjects who report dreams frequently (Dreamers, D) versus rarely (Non-Dreamers, ND). During EPRs data acquisition, participants (18 D and 18 ND) passively listened to sounds while they were either watching a silent movie or sleeping at night. PET data were acquired in the afternoon while participants (21 D and 20 ND) were resting (wakefulness) or sleeping (N2, N3 and REM sleep). ERPs results revealed that the primary steps of auditory processing (N1 and MMN) match in Dreamers and Non-Dreamers. However, latter responses, reflecting higher cognitive processing, dramatically differ in the two groups during pre-sleep wakefulness and during sleep. In the PET study, D vs ND contrast showed rCBF increases in TPJ during REM sleep, N3, and wakefulness, and in MPFC during REM sleep and wakefulness. This study reveals for the first time functional neuroanatomical correlates of the ability to recall dreams in healthy subjects and argue in favor of the forebrain "dream-on" hypothesis (Solms 2000). Results of the two studies support the hypothesis that high/low dream recall frequency is associated with particular cerebral functional organisation independent of the state of vigilance.

FREQUENTIST AND BAYESIAN PROBABILITIES ARE ENCODED SEPARATELY IN THE BRAIN Mathieu d'Acremont[1], Wolfram Schultz[2], Peter Bossaerts[1]; [1]California Institute of Technology, [2]University of Cambridge — When predicting uncertain events, people need to combine two sources of information. The first one comes from prior knowledge, e.g. the probability that it will rain during the weekend reported in a weather forecast. The second source comes from experience, e.g. day after day we can observe if it is raining or not and update our prediction for the weekend. We conducted two fMRI studies to explore how the brain encoded probabilities based on these two sources of information. In the first study, young adults learned the probabilities of stochastic events by observing their repeated occurrences (sampling) and then used these probabilities to make decisions. Results showed that BOLD response in bilateral angular gyrus and medial prefrontal cortex increased with event probabilities in the sampling period. Further analyses revealed that activities in these regions and the posterior cingulate cortex were interconnected and decreased during the task, pointing to the engagement of the default mode network. In the second study, we manipulated prior information about stochastic events as an additional factor. Results showed that frequentist probabilities were encoded in the same network. Bayesian probabilities – which combine prior knowledge with new evidence – were encoded in the bilateral dorsolateral prefrontal cortex. Here brain activation increased when a rare event occurred, thus reflecting a response of "surprise". It can be concluded that frequentist and Bayesian probabilities are encoded in separate networks in the brain. The role of the default network, memory, and prediction errors in probability learning is discussed.

THE EFFECTS OF INADEQUATE SLEEP ON BRAIN FUNCTION DURING RISK TAKING IN ADOLESCENCE (GSA WINNER) Eva Telzer[1], Andrew Fuligni[1], Adriana Galvan[1]; [1]UCLA — Inadequate sleep is endemic among adolescents. Sleep deprivation relates to a host of cognitive and emotional deficits including diminished attentional control, greater arousal, and poorer emotion regulation. This raises important concerns about the health consequences of sleep during adolescence. Adolescence is a time of heightened risk taking behavior, and sleep problems may underlie some aspects of risk taking. In the current study, we examined the effects of sleep on brain function during risk-taking among adolescents. During a functional brain scan, 46 adolescents completed The Balloon Analogue Risk Task (BART), which measures risk taking behavior and cognitive control. Participants also completed the Pittsburgh Sleep Quality Index, which measures sleep quality and sleep problems in the past month. Results suggest that adolescents with poorer sleep quality and greater sleep problems have higher mean pumps on the BART, an index of riskier behavior. At the neural level, adolescents who reported more sleep problems and poorer sleep quality showed decreased activation in the insula when making increasing pumps, a brain region involved in risk monitoring. Thus, poor sleep may lead to a compromised neural risk monitor, resulting in riskier behavior during adolescence. Moreover, when cashing out, poorer sleep quality was related to increased insula as well as increased dorsolateral prefrontal cortex (DLPFC) activation, a brain region involved in cognitive control. Thus, adolescents with poorer sleep may need to recruit more cognitive control and risk monitoring in order to make the decision to stop pumping and cash out.

Slide Session 5

LANGUAGE

Monday, April 2, 3:00 - 5:00 pm, Red Lacquer Room

Chair: Gina Kuperberg

Speakers: Nora Raschle, Simon W. Davis, Zhenghan Qi, Yi Guo, Leonardo Fernandino, Tristan Davenport, Giovanna Egidi, Neil Cohn

ABSTRACTS

THE DEVELOPMENT OF PHONOLOGICAL PROCESSING SKILLS IN POOR AND GOOD READERS: A STUDY FROM PRESCHOOL TO KINDERGARTEN Nora Raschle[1], Jennifer Zuk[1], Nadine Gaab[1]; [1]Children's Hospital & Harvard Medical School, Boston — Phonological processing (PP) skills have been shown to be critical for the development of reading skills. The ability to map sounds to their written counterparts precedes and predicts later reading ability (e.g.; Mann & Dittuno, 1990). Previous studies suggest that those with reading disability show hypoactivation during phonological processing in occipitotemporal/temporoparietal brain regions (e.g.; Richlan et al., 2011). However, it remains unclear how PP develops from the pre-reading to emerging reader stage and whether the developmental trajectories differ between future good and poor readers. Using whole brain fMRI, we investigated the development of PP with a first sound matching compared to a voice matching task in twenty-eight English speaking children prior to and after one year of kindergarten. Children were grouped into poor and good readers

depending on their timed reading scores (TOWRE) after one year of reading instruction. ROI analyses in year1 and year2 were performed in order to investigate PP development within left-hemispheric occipito-temporal/temporoparietal cortex. Prior to kindergarten onset, children who were one year later classified as poor readers already show reduced activation during PP within left-hemispheric occipitotemporal/temporoparietal brain areas when compared to good readers. This neural disruption in occipitotemporal/temporoparietal areas during PP in poor readers persists after one year of reading instruction. Our longitudinal study will investigate whether these neural differences may be utilized as early predictors of later reading (dis-)abilities. An early identification of poor readers or children at risk for reading disability may help prevent negative clinical, psychological and social consequences of reading failure.

TASK-RELATED EFFECTS ON THE NEURAL NETWORKS INVOLVED IN COGNITION: IMPLICATIONS FOR AGING STUDIES Simon W. Davis[1], Jie Zhuang[1], Paul Wright[1], Meredith A. Shafto[1], Lorraine K. Tyler[1]; [1]Centre for Speech, Language and the Brain, University of Cambridge — It is widely assumed that cognitive functions decline with age and that these decrements are associated with age-related changes in patterns of functional activity. However, these studies typically use tasks which may not be orthogonal to the cognitive function being investigated, raising the possibility that the observed age-related functional changes may be due to increased responsiveness to task demands and not to core cognitive functions themselves. To test this hypothesis we scanned healthy subjects [aged 19-76] in 2 studies. In one, subjects passively listened to spoken sentences [no-task condition] while in the other they performed an acceptability judgment task [task condition]. We observed consistent activation of the language network (MTG, LIFG) in both task and no-task studies, and was similarly sensitive to syntactic ambiguity in both studies, suggesting that it persists regardless of additional task demands. Furthermore, this network showed an age-related reduction only during the task, but not in the no-task variant. In contrast, the remaining 3 networks were only present during the task study. Furthermore, increases in functional connectivity between task-related networks dissociated correct and incorrect responses in older but not younger adults, suggesting an age-related shift in processing to regions outside the language network when a task is involved. Our findings suggest that the language network remains consistently activated regardless of cognitive demands. Furthermore, age-related differences only emerged when a task not essential to core language function was introduced, suggesting that we may be under-estimating the extent to which cognitive functions remain stable across the adult life-span.

NEUROCOGNITIVE PLASTICITY IN VERB BIAS LEARNING: AN ERP STUDY (GSA WINNER) Zhenghan Qi[1], Susan Garnsey[1]; [1]University of Illinois, Urbana-Champaign — The likelihood of structural alternatives for verbs (verb bias) guides sentence comprehension [MacDonald et al., 1994; Trueswell & Kim, 1998; Garnsey et al., 1997] Verb-bias learning was investigated by monitoring EEG during training on sentences containing novel verbs. A post-training picture-matching task probed learning. Sentences contained prepositional phrases that could be verb instruments or direct-object modifiers, and were disambiguated by critical noun meaning. (1) Instrument Ambiguous / Unambiguous: The suntanned farmer dakked the corn {with/using} the big tractor... (2) Modifier Ambiguous / Unambiguous: The suntanned farmer dakked the corn {with/that has} the high stalks... Novel verbs were trained in ambiguous (with) sentences or unambiguous (using/that has) sentences. Picture-matching and EEG responses suggest instrument-bias learning only in ambiguous sentences. Early in training, N400 was smaller for instruments (tractor) than modifiers (stalks), suggesting greater ease in processing nouns consistent with instrument predictions. Later in training, the effect changed to a reduced P600 for instruments, suggesting that instrument attachment structures became easier to process as novel verbs' instrument biases increased. The transition from N400 to P600 (consistent with previous results in second language and artificial language learning [Osterhout et al., 2006; 2008; Friederici et al., 2002]) was observed mainly in ambiguous conditions containing with-phrases, suggesting that resolving ambiguity might be a crucial component of verb bias learning.

NEURAL BASIS OF SEMANTIC AND SYNTACTIC INTERFERENCE RESOLUTION IN SENTENCE COMPREHENSION Yi Guo[1], Randi Martin[1], Cris Hamilton[1], Julie Van Dyke[2], Yingying Tan[1]; [1]Rice University, [2]Haskins Laboratories — During sentence comprehension, it is often necessary to retrieve earlier information (e.g., the sentential subject) to link with later information (e.g., the main verb) across some intervening material (e.g., a relative clause). Interference in retrieving the subject of a verb has been observed when the intervening material contains a noun having features matching the semantic or syntactic retrieval cues generated by the verb. The purpose of the present study was to determine the brain regions involved in resolving such semantic and syntactic interference during sentence comprehension. In a 2 (low semantic vs. high semantic interference) × 2 (low syntactic vs. high syntactic interference) design, brain activity was measured using fMRI while subjects read sentences and answered comprehension questions following the sentence. Two regions in the LIFG (BA 45 & 44) showed greater activation for the high than the low SYNTACTIC interference conditions during sentence reading. Two regions in the LIFG (BA 45 & 47) showed greater activation for the high than the low SEMANTIC interference conditions, but during question answering. In a conjunction analysis, regions in BA 45 & 44 showed a large degree of overlap during the resolution of semantic and syntactic interference. The semantic interference region in BA 47, however, did not overlap with any region involved in resolving syntactic interference. The results implicate the LIFG in resolving semantic and syntactic interference during sentence comprehension, but with a different time course and somewhat different brain regions involved in resolving the two types of interference.

WHERE IS THE ACTION? ACTION SENTENCE PROCESSING IN PARKINSON'S DISEASE (PFA WINNER) Leonardo Fernandino[1], Lisa Conant[1], Jeffrey Binder[1], Karen Blindauer[1], Bradley Hiner[1], Katie Spangler[1], Rutvik Desai[1]; [1]Medical College of Wisconsin — According to an influential view of conceptual representation, action concepts are understood through motor simulations, involving cortical motor regions of the brain. A stronger version of this embodied account suggests that even figurative uses of action words (e.g., "grasping the concept") are understood through motoric simulations. The necessity of motor systems in language comprehension can be established if patients with motor impairments show selective deficits for action language. We compared the performance of 20 patients with Parkinson's disease (PD) with that of 21 age-matched controls on a sentence meaningfulness judgment task, where the sentences belonged to one of four conditions: literal action, non-idiomatic metaphoric action, idiomatic action, and abstract. The same verbs (referring to hand/arm actions) were used in the three action-related conditions. Patients were slower to respond to literal action than to abstract sentences ($p = .006$), but not controls ($p = .46$), with a significant interaction ($p = .03$). A similar interaction was found for idiomatic sentences ($p = .047$), but not for the metaphoric ones. For metaphoric sentences, however, a marginal effect was seen in accuracy, whereby lower accuracy for metaphoric relative to abstract sentences was seen for the patient group relative to controls (interaction $p = 0.07$). These results support a view in which sensory-motor systems are causally involved in language comprehension, even extending to figurative language. The pattern of impairment suggests context-sensitivity in embodiment, whereby sensory-motor involvement is gradually reduced as language becomes more figurative and formulaic. Acknowledgment: Supported by NIH R01 DC010783 (RD).

ONE LEG, AN ARM, AND A SHARK: ERP EFFECTS OF LEXICAL ASSOCIATION AND CAUSAL INFERENCE IN DISCOURSE Tristan Davenport[1], Seana Coulson[1]; [1]University of California, San Diego — We used event-related potentials to compare the impact of discourse context on visually presented probe words that were either lexical associates of the

final word in the discourse (lexically related), related to a causal inference prompted by the discourse (causally related), or were unrelated to the preceding discourse. In experiment 1, participants heard short stories containing causal coherence gaps, necessitating a causal bridging inference (e.g., "The surfer took his board out into the waves. He started screaming and emerged with one leg."). At the end of each story, one of four visual probe words was presented: causally related to the coherence gap (SHARK), lexically related to the story's final word (ARM), or one of two unrelated conditions drawn from the lists of causal and lexical words to serve as controls (PUNCH, SLEEP). N400s elicited by causally related probes were slightly smaller than those elicited by lexically related probes; unrelated probes did not differ. In Experiment 2, discourse primes comprised only the story's second sentence. Neither related nor unrelated probes differed from each other. In Experiment 3, the length of the discourse prime was varied within-subjects, and only causally related and lexically related probes were included. Words following long contexts elicited smaller N400s than after short contexts. Following long contexts only, causally related probes elicited marginally smaller N400s than lexically related probes. In sum, manipulation of context length affected causal and lexical processing, consistent with a dynamic parser in which discourse context can affect lexical associative processing.

INTEGRATION PROCESSES COMPARED: CORTICAL DIFFERENCES FOR LISTENING AND EVALUATION IN DISCOURSE COMPREHENSION Giovanna Egidi[1], Alfonso Caramazza[1,2]; [1]University of Trento, [2]Harvard University — This research investigates the neural bases of two integration processes involved in discourse comprehension: natural comprehension (i.e., ordinary listening) and evaluation (i.e., performing a consistency judgment). In an fMRI experiment, fourteen participants listened to stories and their endings and fourteen different participants evaluated the fit of these endings with prior context. Two variables were manipulated within stories: 1. endings were either consistent or inconsistent with the immediately preceding (local) context, and 2. distal (global) context was either relevant or irrelevant for the integration of the ending: when global context was irrelevant, the consistency of the ending was determined only by local context, but when global context was relevant, the consistency of the ending depended on both local and global context. Behavioral research shows that access to distal portions of the discourse is not always necessary during natural comprehension, but is prominent during consistency evaluation. This process, in fact, prompts more global consideration of prior context. Consistently, in our experiment, a network including temporal areas (STG, STS) and medial areas (precuneus, PHG) showed greater sensitivity to global context during evaluation than during listening. By contrast, parietal cortex (AG, postCG, preCG), medial areas (CingG, CingS), and insular cortex showed sensitivity to local context during listening but not during evaluation. Finally, regions often associated with semantic processing (IFG, SFG, STG, STS, AG) showed greater activation during evaluation than during listening. These results show that natural comprehension and evaluation involve processing different amounts of contextual information and are performed by different cortical regions.

CONSTITUENCY STRUCTURE IN VISUAL NARRATIVE: EVIDENCE FROM READING TIMES AND EVENT-RELATED POTENTIALS Neil Cohn[1], Ray Jackendoff[2], Phillip Holcomb[1], Gina Kuperberg[1,3]; [1]Psychology Department, Tufts University, [2]Center for Cognitive Studies, Tufts University, [3]Department of Psychiatry, Massachusetts General Hospital — Recent research has suggested that the visual narratives found in comics are organized with a hierarchic narrative "grammar." We conducted experiments inspired by Fodor and Bever's classic "click" studies of syntax, which examined constituency by introducing disruptions at or after clause boundaries in sentences. We inserted blank "disruption" panels Before, At, or After the constituency boundary in comic strips designed using Cohn's model of visual narrative. In Experiment 1, participants viewed sequences panel-by-panel at their own pace. Blanks were viewed for longer After the boundary than Before or At the boundary. Spill-over effects appeared two panels after the disruption, with shorter viewing times in the At condition than in either the After or the Before conditions. These findings suggest the presence of constituency structure because disruptions within constituents had greater impact on viewing times than disruptions between, constituents. Experiment 2 measured ERPs to panels in the same sequences. A larger anterior negativity was seen to blanks within constituents (Before/After) than between constituents (At). This indicates that disruptions of constituency are recognized even before the subsequent panel appears. A P600 effect was also seen to blanks After the boundary (within the second constituent) relative to those in the first constituent (Before/At). This may reflect a continued analysis as participants attempted to integrate the second constituent with the first. Altogether, these results suggest that a narrative structure, organized into constituents, is used during the comprehension of sequential images.

Slide Session 6

LONG-TERM MEMORY

Tuesday, April 3, 10:00 am - 12:00 pm, Red Lacquer Room

Chair: Lila Davachi

Speakers: Chien-Ho Janice Lin, Thomas Reber, Tyler Davis, Vishnu Murty, Sean M. Polyn, Brice Kuhl, Ilana Dew, Pamela LaMontagne

ABSTRACTS

LESIONS OF THE STRIATUM ABOLISH THE BENEFIT OF INTERLEAVED PRACTICE ON MOTOR SEQUENCE LEARNING AND CORTICOMOTOR BOLD SIGNAL Chien-Ho Janice Lin[1], Ming-Chang Chiang[2], Allan D Wu[1], Parima Udompholkul[1], Omid Yazdanshenas[1], Renee E Shimizu[1], Barbara Knowlton[1]; [1]University of California, Los Angeles, USA, [2]National Yang-Ming University, Taiwan — Practice of different tasks in an interleaved order generally induces superior retention compared to practicing in a repetitive order, a phenomenon known as the contextual-interference (CI) effect. We used fMRI to investigate whether the CI benefit in behavioral performance is associated with changes in blood oxygen level-dependent (BOLD) signal for patients with subcortical stroke. 14 patients with striatal (ST) or extrastriatal (ExST) stroke and 16 control subjects practiced serial reaction time tasks with the less-affected hand where a set of three 4-element sequences were arranged in a repetitive or an interleaved order on 2 successive days. Retention tests took place on Day 5. Subjects practiced sequences in both Repetitive and Interleaved conditions in separate sessions 2-4 weeks apart. BOLD signal was measured throughout the course of practice. In controls and ExST patients, we identified a CI effect in that while reaction times (RT) in the Interleaved condition were slower than the Repetitive condition during practice ($p < .05$) the reverse was true during retention on Day 5, with faster RT for sequences practiced in the Interleaved condition ($p < .05$). This pattern was not identified in ST patients. During practice, control subjects and ExST patients demonstrated increased BOLD in the corticomotor network during Interleaved training but the ST patients showed increased BOLD during Repetitive training ($p < .05$, FDR corrected). We demonstrated that the CI effect is present in stroke patients if the striatum is spared. Our data provide behavioral and neurophysiological support for striatal function in the CI benefits to motor learning.

UNCONSCIOUS RELATIONAL INFERENCE RECRUITS THE HIPPOCAMPUS Thomas Reber[1,2], Roger Luechinger[3], Peter Boesiger[3], Katharina Henke[1,2]; [1]University of Bern, [2]Center for Cognition, Learning, and Memory, Bern, [3]Institute for Biomedical Engineering, University and ETH Zurich — Relational inference denotes the capacity to encode and flexibly retrieve multiple memories to combine knowledge from several episodes to improve decision-making. Although relational inference is thought to depend on the hippocampus and consciousness, we now show that it also occurs outside consciousness but still recruits the hip-

pocampus. In temporally distinct and unique subliminal episodes, we presented word pairs that either overlapped ('winter-red', 'red-computer') or not. Effects of unconscious inference emerged in reaction times recorded during encoding and in the outcome of decisions made one minute later at test, when participants judged the semantic relatedness of two supraliminal words. These test words were either episodically related through a common word ('winter-computer'), or were unrelated. Hippocampal activity increased during unconscious encoding of overlapping versus non-overlapping word pairs and during the retrieval of episodically related versus unrelated words. Hippocampal activity at encoding predicted the outcome of decisions at test. Together, unconscious inference may influence decision-making in new situations.

PATTERN SIMILARITY IN PARAHIPPOCAMPAL CORTEX PREDICTS PERCEPTIONS OF GRADED STRUCTURE Tyler Davis[1], Russell Poldrack[1]; [1]University of Texas at Austin — How categories are represented continues to be a hotly debated topic across neuroscience and psychology. One topic that is central to cognitive research on category representation surrounds the determinants of graded structure- the quantitative manner in which typicality or goodness-of-membership differs between members of a category. Graded structure has proven difficult to fully explain at the psychological level, as sometimes objects that are average or share a family resemblance with other category members are viewed as most typical, whereas in other cases objects that are ideal or physical caricatures of their category are viewed as the most typical. Here we investigate the internal structure of category representations by exploring how graded structure is coded in multivariate patterns of activation in the brain as subjects categorize novel line-drawn birds. We introduce a novel measure of neural typicality that is based on the pattern similarity between activation elicited for an object and other members of its category, to determine whether the brain organizes categories around physically average or ideal category members. We find that, as objects become more physically ideal members of their category, their neural pattern similarity to other category members increases, suggesting that the parahippocampal cortex organizes category representations so as to favor unambiguous, idealized stimuli. These results are exciting because they provide direct evidence about how graded structure is manifest in the brain, and because they suggest that critical information about cognitive structure may be present in the relationships between multivariate patterns of activation in the brain.

REWARD MOTIVATION INCREASES HIPPOCAMPAL SENSITIVITY TO AND MEMORY FOR EXPECTANCY VIOLATIONS (GSA WINNER) Vishnu Murty[1], R. Alison Adcock[1]; [1]Duke University — Reward motivation has been demonstrated to enhance declarative memory formation, however, identifying mechanisms of this enhancement is an area of active research. Previous research suggests that activation of reward systems promotes the exploration of novel, changing environments. Because the hippocampus has been demonstrated to preferentially encode novel, changing features (i.e. expectancy violations), we hypothesize that reward motivation could enhance memory by increasing hippocampal sensitivity to expectancy violations. To test this hypothesis, we collected fMRI data while participants performed a rewarded target detection task that included expectancy violations among repeated object stimuli. During high and low reward motivation conditions, participants saw (1) 9 to 11 serial repetitions of the same trial-unique object or (2) 8 to 10 repetitions of the same trial-unique object, interrupted by an unexpected presentation of a novel, highly similar, object that constituted an expectancy violation. Reward motivation during encoding increased participants' later recognition of objects that constituted expectancy violations, even though memory was not incentivized. FMRI analyses revealed that reward motivation enhanced activations throughout the mesolimbic dopamine system. The presence of expectancy violations enhanced activations throughout the fronto-parietal network, ventral visual stream, and hippocampus. Critically, in the hippocampus, fMRI responses to expectancy violations were greater following high versus low reward cues. These results demonstrate that reward motivation increases hippocampal sensitivity to expectancy violations and promotes the encoding of surprising stimuli. The findings thus provide a mechanism by which reward motivation may enhance the encoding of salient features within an individual's environment, even when memory is not incentivized.

CATEGORY-SPECIFIC NEURAL OSCILLATIONS PREDICT RECALL ORGANIZATION DURING MEMORY SEARCH Sean M. Polyn[1], Neal W Morton[1], Michael J. Kahana[2]; [1]Vanderbilt University, [2]University of Pennsylvania — The human memory system behaves like an internet search engine: retrieval cues are constructed that serve as search terms, and these cues allow us to target particular aspects of past experience. The Context Maintenance and Retrieval (CMR) model describes how an internally maintained context representation, sensitive to the temporal, semantic, and source characteristics of studied material, is constructed, and is then used as a retrieval cue to guide memory search. By this model, the order in which participants retrieve studied material during a free-recall period reflects the structure and dynamics of this representation. In two free-recall studies using scalp EEG and intracranial ECoG, we find patterns of oscillatory neural activity whose dynamics support this context-based view of memory search. During study, stronger category-specific patterns are seen for items that will later be remembered alongside items from the same category, than for items that will be remembered alongside items from the other categories (the subsequent clustering effect). Furthermore, the rate at which these category estimates rise as the participant studies a series of items from the same category predicts the degree of category organization that will be observed, which is consistent with the integrative mechanisms of the CMR model. Finally, these patterns show rich dynamics during search itself, rising in strength when participants cluster studied material along a particular dimension. These results will be discussed in terms of potential explanatory mechanisms suggested by context-based modeling frameworks.

INCIDENTAL MEMORY REACTIVATION DURING RETRIEVAL PROMOTES FUTURE REMEMBERING Brice Kuhl[1], Marcia Johnson[1], Marvin Chun[1]; [1]Yale University, Department of Psychology — Testing memory for an event promotes future remembering of that event. But how does testing one feature of an event affect memory for other features of that event? Here, we applied pattern classification analyses to fMRI data to assess whether retrieving one feature of an event elicits 'incidental' neural reactivation of other event features, and, whether such reactivation is related to future remembering. During fMRI scanning, participants engaged in alternating study-test rounds. In study rounds, words were paired with images of faces or scenes that appeared on the left- or right- hand side of the screen. During test rounds, words were presented and subjects were either instructed to recall the location (left/right; 1/3 of study items) or category (face/scene; 1/3 of study items) of the corresponding image; for the remaining 1/3 of study items, neither feature was tested. After scanning, participants completed a post-test that tested memory for both features (location and category) for each studied word. Pattern classification analyses revealed robust neural reactivation of feature information during the test rounds, including reactivation of non-target features (e.g., reactivation of face/scene information during location retrieval). Moreover, non-target features were much better remembered at post-test than features of items that were not tested at all--an effect that was related to the degree of incidental neural reactivation during test rounds. These results indicate that retrieving one feature of an event can elicit incidental neural reactivation of other event features, thereby shaping future remembering.

CREATING ILLUSORY MEMORIES WITH MASKED PRIMING (PFA WINNER) Ilana Dew[1], Roberto Cabeza[1]; [1]Duke University — Fluency can create illusory memories, whereby more fluently processed items are more likely to be endorsed as familiar. Fluency can be experimentally manipulated, but can also occur incidentally, particularly during standard recognition tests in which studied items may be processed more fluently than new items. Familiarity memory has been linked with retrieval-related deactivations in the perirhinal cortex (PrC). PrC has also

been linked with conceptual implicit memory, suggesting that semantic fluency may at least partly account for the contribution of this region to familiarity. An event-related fMRI study of recognition memory presented old and new targets, and perceived oldness was measured using a scale from 1 (definitely new) to 6 (definitely old). Each target was preceded by a 40-ms prime that was either semantically related or unrelated to the target. Relative to unrelated-prime trials, semantically-primed trials increased behavioral "oldness" rating. During unstudied trials, the fMRI data showed an interaction between priming condition and response in right PrC, with deactivations during false alarms relative to correct rejections, unique to the semantic prime condition. We then modeled individual trials by a separate covariate, yielding beta estimates in the PrC ROI for each trial in each subject. On this within-subjects, trial-to-trial basis, PrC deactivations predicted mean oldness rating during semantically primed trials (both new and old). The results indicate a role of the PrC in fluency-derived feelings of oldness, independently from the encoded memory trace, suggesting that fluency may partially underlie the common role of PrC in familiarity memory and conceptual implicit memory.

PROSPECTIVE MEMORY: A NEURAL INVESTIGATION OF THE MULTIPROCESS MODEL Pamela LaMontagne[1], Bruna Martins[1], Michael Scullin[1], Todd Braver[1], Mark McDaniel[1]; [1]Washington University in St. Louis — Prospective memory (PM) is the process of retrieving an intention after a delay, such as delivering a message. The Multiprocess Model (McDaniel & Einstein, 2007) posits that the retrieval of these intentions can occur by two different processes: strategic monitoring or spontaneous retrieval. Tasks that rely on nonfocal cues, targets outside the focus of an ongoing task, typically demonstrate both behavioral and brain-based markers of strategic monitoring, such as PM task blocks showing increased RTs and sustained aPFC activity. Prior behavioral studies have demonstrated PM tasks involving focal cues, targets within the focus of an ongoing task, fail to demonstrate markers of strategic monitoring, thereby suggesting a reliance on spontaneous retrieval processing. We conducted the first fMRI study directly comparing focal and nonfocal PM to test whether these two PM tasks differ in sustained vs. transient (event-related) brain activity dynamics. Task-related analysis showed significant sustained activity for the nonfocal task, including the aPFC, but an absence of sustained activity in the focal condition. Both focal and nonfocal tasks were associated with transient activity for PM targets compared to ongoing items in bilateral prefrontal, hippocampal, temporal, and parietal cortices. A psychophysiological interaction (PPI) revealed significantly greater functional connectivity in the focal condition between hippocampal seeds and bilateral aPFC. This double dissociation supports differential processing for strategic monitoring, via sustained aPFC activity, and spontaneous retrieval, via connectivity between the hippocampus and aPFC, in line with the Multiprocess Model of PM.

Slide Session 7

EMOTION AND SOCIAL

Tuesday, April 3, 1:00 - 3:00 pm, Red Lacquer Room

Chair: Kevin Oschner

Speakers: Helen Weng, Jamil Zaki, Lauren A. Leotti, Eliza Bliss-Moreau, Robert Spunt, Jennifer Silvers, Carien van Reekum, Jason Buhle

ABSTRACTS

MULTI-VOXEL PATTERN ANALYSIS OF BRAIN STATES AFTER COMPASSION TRAINING PREDICTS CHARITABLE DONATIONS (GSA WINNER) Helen Weng[1], Jarrod Lewis-Peacock[2], Diane Stodola[1], Richard Davidson[1]; [1]University of Wisconsin-Madison, [2]Princeton University — Although compassion is an important emotional determinant of altruistic behavior, little is known about whether compassion can be cultivated through training. Here, we investigated the neural bases and behavioral outcomes of compassion training; specifically, we tested whether short-term compassion training could alter brain functioning and subsequently impact altruistic behavior. Participants (N=28) practiced two weeks (30 minutes daily) of compassion meditation via the Internet. Brain activity was measured with fMRI both pre and post-training, and multi-voxel pattern analysis (MVPA) was used to assess the stability of compassion-related brain activity patterns in each session. To assess altruistic behavior after training, participants were given the opportunity to donate their earned money to charity. In each session, participants were instructed to voluntarily generate compassion for (Compassion) or simply attend to (Attend) pictures depicting human suffering (Suffering) or non-suffering (Neutral). After training, the pattern classifier decoded brain states more accurately in Compassion-Suffering trials (Pre: 28.5% [chance: 25%]; Post: 33.5%; $t_{167}=3.7$, $P<0.001$). This result indicates that brain patterns elicited while generating compassion towards images of suffering became more reliable after compassion training. Critically, the post-training reliability of an individual's Compassion-Suffering brain patterns was predictive of the amount of money the individual donated to charity ($rho_{27}=0.51$, $P=0.005$). This pattern was not found in the other conditions, and the analogous condition in a reappraisal training control group did not predict donations ($rho_{27}=0.04$, $P=0.82$). These data suggest that compassionate brain states can be trained and, in turn, these post-training states can lead to increased altruistic behavior.

EQUITABLE DECISION-MAKING IS ASSOCIATED WITH NEURAL MARKERS OF VALUE (PFA WINNER) Jamil Zaki[1], Jason Mitchell[1]; [1]Harvard University — Standard economic and evolutionary models assume that humans are fundamentally selfish. On these views, prosocial acts?such as cooperation or altruistic giving?result from covert attempts to avoid external social pressures against selfishness. However, even in the absence of such pressure, individuals routinely forego personal gain to share resources with others. Such anomalous giving cannot be accounted for by standard models of social behavior, and implies additional sources of prosociality. One possibility is that individuals imbue social ideals—such as equity or charity—with irreducible value. However, the role of such value in prosocial decision-making remains unexplored. Here we addressed this gap in knowledge by examining brain activity during equitable and inequitable choices. In this study, individuals made iterated choices between allocating varying amounts of money either to themselves or to another participant. Critically, this other participant did not know of these choices and could not punish unfair decisions, reducing external pressures to act fairly. Nonetheless, individuals made prosocial choices on a nontrivial proportion (~36%) of trials. Further, making equitable choices (i.e., fairly distributing money on a given trial) engaged the orbitofrontal cortex—a structure involved in computing subjective value—even when doing so required participants to forego personal profit. By contrast, making inequitable decisions engaged anterior insula, a region linked to the experience of disutility. Moreover, insula response predicted individuals' unwillingness to make inequitable choices. Together, these data suggest that, instead of mere responses to external pressure, prosocial acts may also reflect a reward signal associated with prosociality that is not reducible to personal gain.

INFLUENCES OF OUTCOME VALENCE ON THE AFFECTIVE EXPERIENCE OF CHOICE Lauren A. Leotti[1], Michael A. Niznikiewicz[2], Victoria K. Lee[3], Mauricio R. Delgado[1]; [1]Rutgers University - Newark, [2]University of Illinois at Urbana-Champaign, [3]Duke University — Converging evidence suggests the perception of control is integral for an individual's general wellbeing. Research has demonstrated that the presence or absence of perceived control can have a significant impact on the regulation of emotion, behavior, and physiology. The present study uses fMRI to examine (a) how the affective experience of choice, the means by which individuals exercise control, differs from that of non-choice, and (b) how the affective experience of choice is modulated by the valence of potential outcomes. We characterize the affective experience of choice by examining

brain activity during the anticipation of choice (vs. non-choice). On each trial, participants were presented with a selection of two keys which could lead to a potential monetary gain (Experiment 1) or a potential monetary gain or loss (Experiment 2). 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). In the context of potential monetary gains, subjects reported a preference for choice trials, and we found that anticipation of choice recruited activity in corticostriatal regions (e.g. ventral striatum) involved in affective and motivational processes. For potential losses, however, there were no areas with significantly greater activity for the choice condition, unless participant's subjective preferences for control were taken into account. Future analyses will address individual differences in the preference for choice in the context of losses and how they modulate activity in affective and motivational brain circuitry.

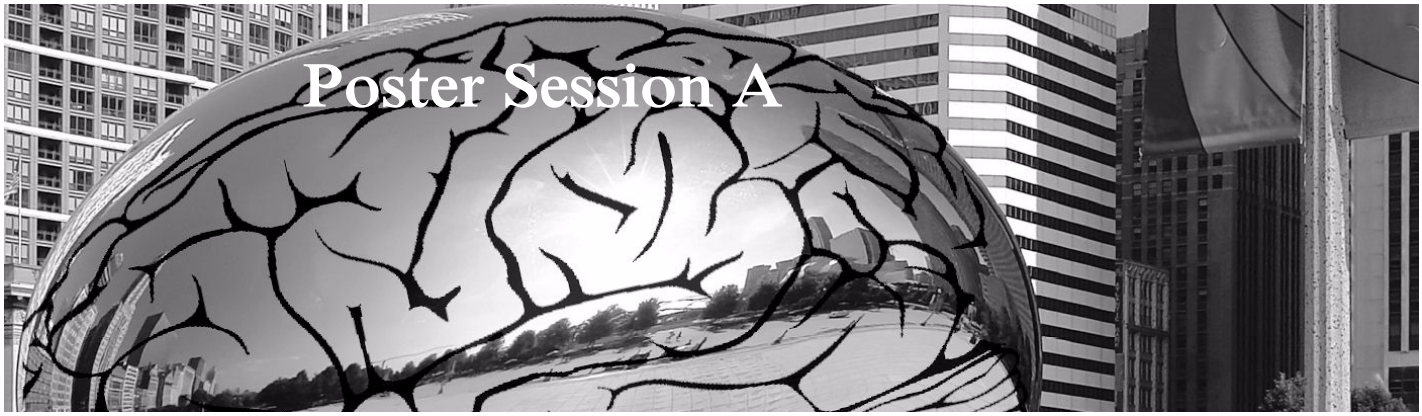
REDUCED SOCIALITY FOLLOWING DAMAGE TO THE MACAQUE ANTERIOR CINGULATE CORTEX Eliza Bliss-Moreau[1], David Amaral[1]; [1]University of California, Davis — The anterior cingulate cortex (ACC) has been broadly implicated in socioemotional processing. In humans, ACC activity has been observed during diverse tasks ranging from the experience of pain to social interactions in virtual environments, and during error detection and action monitoring, two processes that likely subserve normal socioemotional behavior. Despite the robust human literature, the extent to which normal ACC function is required to execute appropriate social behavior is not clear. Previous reports of social behavior following ACC damage in nonhuman primates are largely inconclusive as result of the lesion technique, the social behavior testing conditions, and/or the method used to collect behavioral data. In the present experiment, we tested the social functioning of a cohort of adult male rhesus macaque monkeys that received either neurotoxic lesions to the ACC (sparing fibers of passage) or sham operations. Experimental animals freely interacted with four neurologically intact partner monkeys (two males and two females) in a large test cage on repeated occasions. Spontaneous social behaviors were recorded using a robust behavioral ethogram. ACC lesioned animals, as compared to controls, spent less time engaged in social interactions, initiated social interactions less frequently and actively avoided partner monkeys' attempts to socially engage them. Further, in the presence of the partner animal that generated the most complex social context, ACC lesioned animals generated higher rates of submission-related behaviors while control animal generated higher rates of dominance related behaviors. Implications for the role of the ACC in the neural system that subserves social behavior are discussed.

THE PHENOMENOLOGY OF COGNITIVE CONFLICT: THE DORSAL ANTERIOR CINGULATE RESPONSE TO STOP-SIGNAL ERRORS TRACKS REPORTS OF NEGATIVE AFFECT Robert Spunt[1], Matthew Lieberman[1], Jessica Cohen[2], Naomi Eisenberger[1]; [1]University of California, Los Angeles, [2]University of California, Berkeley — One of the most reliable observations in cognitive neuroscience is the response of dorsal anterior cingulate cortex (dACC) to events that demand increased cognitive control (e.g., errors). While this observation suggests the dACC plays an important role in executive function, a comparably reliable observation is an association of dACC activity with the experience of negative affective states such as pain, fear and anxiety. Importantly, the phenomenology of the tasks used to investigate executive function has so far been ignored, and hence it remains unknown to what extent the dACC response to these tasks is explained by fluctuations in task-induced negative affect. In an fMRI study, participants performed a stop-signal task while regularly reporting on their affective experience. We observed that within-subject variability in the dACC response to errors tracked changes in negative affect throughout task performance. This association remained even when controlling for changes in attention, effort, and error frequency. This demonstrates that the dACC is associated with the experience of negative affect even during performance of tasks designed to isolate cognitive processes. While this 'affective' description of dACC function may appear to be at odds with its known role in 'cognitive' function, an alarm model of the dACC simultaneously accounts for both by assuming that the dACC is involved in detecting goal discrepancies and generating a motivational signal. More generally, the results illustrate the utility of measuring aspects of phenomenology for understanding the neural correlates of cognitive performance.

RECRUITMENT OF VENTROMEDIAL PFC IS ASSOCIATED WITH THE SPONTANEOUS REGULATION OF NEGATIVE EMOTION Jennifer Silvers[1], Tor Wager[2], Jochen Weber[1], Kevin Ochsner[1]; [1]Columbia University, [2]University of Colorado, Boulder — While numerous neuroimaging studies have examined what happens when individuals are given an explicit goal to regulate, in our everyday lives, it is likely that spontaneous tendencies, rather than explicit goals, underlie many instances of emotion regulation. However, no prior studies have directly investigated what neural systems modulate negative affect during uninstructed viewing of emotional stimuli. The present study sought to investigate this issue by asking participants to respond naturally to aversive and neutral stimuli. Using participants' self-reported negative affect, we then examined what patterns of neural activity predicted 1) less negative affect on a trial-by-trial basis within participants (phasic effects), and 2) stable differences in negative affect between individuals (tonic effects). Activation in left dorsolateral PFC, an area that is commonly recruited by paradigms with explicit regulatory goals, predicted less negative affect on a trial-by-trial basis within individuals. However, only activity in ventromedial PFC, a brain region known to support regulatory processes that are not driven by explicit regulatory goals (such as fear extinction and reversal learning), predicted less negative affect both within and between individuals. Taken together, these results provide novel insight into how prefrontal control systems modulate negative affect in the absence of experimental instruction and suggest that VMPFC may be conceptualized as a unique biomarker for both phasic and tonic levels of negative affect.

A LATERAL-MEDIAL SHIFT IN PREFRONTAL CORTICAL ENGAGEMENT UNDERLIES INTACT EMOTIONAL PROCESSING IN AGING Carien van Reekum[1], Stacey Schaefer[2], Regina Lapate[2], Tom Johnstone[1], Aaron Heller[2], Catherine Norris[3], Patricia Tun[4], Margie Lachman[4], Carol Ryff[2], Richard Davidson[2]; [1]University of Reading, [2]University of Wisconsin-Madison, [3]Dartmouth College, [4]Brandeis University — The capacity to adaptively respond to negative emotion is in part dependent upon lateral areas of the prefrontal cortex (PFC) that are subject to age-related atrophy and associated loss in executive function, and in part upon ventromedial PFC areas (VMPFC). We used structural and functional MRI to test the hypothesis that increasing age is associated with a prefrontal lateral-medial shift in processing of negative information, and that this shift is dependent upon grey matter probability (GMP) in lateral PFC. We further tested whether such a shift is associated with cognitive decline and impacts psychological well-being (PWB). Participants (N=64, 38 – 79 years) viewed negative and neutral pictures for 4 s each while in the scanner. They also completed a battery of cognitive tests and provided self-reports of PWB. The FMRI data demonstrate reduced recruitment of left ventrolateral PFC (VLPFC) and increased VMPFC response with increasing age when watching negative pictures, while age did not correlate with amygdalar responding. GMP in VLPFC was associated with VMPFC activation, but did not mediate the age-VMPFC relationship. VMPFC activation was further associated with performance in a switch task and with PWB. We conclude that a shift from lateral to medial PFC underlies emotional processing with advancing age. While this shift is associated with atrophy in lateral PFC and a relative loss of inhibitory control, compensation for atrophy does not mediate this shift. Our results suggest increased engagement of VMPFC as people age may promote greater PWB in later life.

DIFFERENT EFFECTS OF DISTRACTION AND PLACEBO ON PAIN PROCESSING Jason Buhle[1], Bradford L. Lawson[1], Chris Stevens[2], Cait M. Williamson[1], Tor D. Wager[3]; [1]Columbia University, [2]University of Connecticut, [3]University of Colorado, Boulder — Distraction and placebo analgesia are two effective psychological manipulations for alleviating pain. Recently, we showed that distraction and placebo do not appear to rely on overlapping cognitive resources, and thus they can be combined to maximize pain relief (Buhle et al., in press). In the present study, we crossed an executive working memory task with an expectancy-based placebo treatment in two separate fMRI sessions in order to directly compare the neural effects of each method of pain relief (n=21). Both distraction and placebo significantly reduced behavioral pain reports. Because pain processing involves a complex network of brain regions, we tested for neural reductions in two independently-derived, whole-brain, pain-predictive pattern maps. The first pattern was generated using machine learning analyses on heat pain data from participants run previously in our lab. The second pattern was generated using 'reverse-inference' meta-analysis on 224 pain imaging studies (neurosynth.org; Yarkoni et al., 2011). Pattern-expression analysis with both maps yielded nearly identical results: While distraction reduced the neural signature of pain in nearly all participants (95% and 90%, respectively, $P < .001$ in both), placebo reductions were not different from chance (38% and 48% of participants). These results call into question whether expectancy-driven placebo effects exert widespread effects on pain processing, and provide a way to distinguish different brain effects of different types of pain modulatory techniques in a principled, a priori fashion.



Saturday, March 31, 5:30 – 7:30 pm, Exhibit Hall

ATTENTION: Auditory

A1

EFFECTS OF AUDITORY CUES ON VISUAL ATTENTION: COST/BENEFITS OF CUE TYPE AND VALIDITY EXPECTANCY Ashley F. Curtis[1], Janna K. Comrie[1], Anthony Colange[1], Susan J. E. Murtha[1]; [1]York University — OBJECTIVE: Auditory cues have been shown to focus attention and facilitate response time (RT) in visual target detection tasks. It is important to determine whether the type or expectancy of auditory cues impacts performance differently on tasks that require different cognitive abilities. Therefore, we examined whether cue type (alerting vs. orienting; Experiment 1) or cue expectancy (60% valid, 70% valid, 80% valid; Experiment 2) were beneficial (RT of valid minus no cue condition) and/or costly (RT of invalid minus no cue condition) to performance on a visual target elevation discrimination task. METHODS: In Experiment 1, the alerting cue was presented simultaneously to the left or right of the target and this was contrasted with an orienting cue presented to either the left or right of the target (50% of the time valid or predictive of target location). In Experiment 2, participants were presented with 3 possible orienting cueing conditions that varied in cue expectancy. RESULTS: As predicted Experiment 1 found that orienting cues provided approximately 2.5 times the cue benefit over alerting cues. Surprisingly, invalid orienting cues exerted no cost on performance. In Experiment 2 we found that both 60% and 80% validity provides the greatest cue benefit. Invalid cues, however, exerted no cost. CONCLUSION: Our findings show that when discriminating stimuli, auditory cues that provide spatial information are more beneficial than alerting cues, despite the non-informative nature of the cue. In addition, the expectation of cue validity affects the extent of auditory cue benefit.

A2

THE N1-SUPPRESSION EFFECT FOR SELF-INITIATED SOUNDS IS NOT INFLUENCED BY ATTENTION Jana Timm[1], Iria SanMiguel[1], Katja Saupe[1], Erich Schröger[1]; [1]University of Leipzig — Self-initiated sounds elicit an attenuated N1 component of the auditory event-related potential compared to externally initiated sounds. It has been suggested that this N1-modulation is mediated by an internal predictive mechanism that would allow discriminating the sensory consequences of one's own actions from those of others. As this particular paradigm is becoming a popular method to investigate predictive processing, it is important to ensure its validity. However, in previous studies, the effect could have been confounded by a differential allocation of attention to self- and externally initiated sounds. The present study investigates to which extent the N1-suppression effect to self-initiated sounds can be explained by attention. We used a mixed design presenting self- and externally initiated sounds in the same block and manipulated the allocation of attention blockwise. Participants had to count either all sounds they could hear, all button presses they made or all extended fixation crosses they saw on a screen, respectively. Thus, attention to the sounds was decreased gradually across these three attention conditions. If attention influences the self-initiation effects, we expected increasing N1-suppression with decreasing attention to the sounds. The results indicate clear N1-suppression for self- compared to externally initiated sounds for all three attention conditions. Interestingly, no interaction between attention and self-initiation effects was found, suggesting that self-initiation effects were not influenced by attention. In conclusion, the present results support the assumption that the N1-suppression effect for self-initiated sounds reflects a genuine effect based on an internal forward mechanism.

A3

RETRO-CUEING LISTENERS' ATTENTION TO SOUND OBJECT REPRESENTATIONS ATTENUATES CHANGE DEAFNESS Kristina C. Backer[1,2], Claude Alain[1,2]; [1]Rotman Research Institute at Baycrest Centre, Toronto, Canada, [2]University of Toronto — According to the object-based account of auditory attention, we can selectively orient our attention to one of several co-existing sound objects within short-term memory (STM). The present study tested this model using complex auditory scenes. We used a delayed match-to-sample change identification task, in which pairs of auditory scenes were either different or identical. Auditory scenes were composed of three concurrent, realistic sounds (e.g., dog bark, piano tone, etc.) that could be easily segregated from one another. In Experiment 1, a 2-second retention interval separated the two scenes presented on each trial. On some trials, participants were cued (100% valid) to a particular sound either at the beginning of the trial before Scene 1 (Pre-Stimulus Cue) or at various times during the retention interval (Retro-Cue). On other trials, no cues were presented. Change identification performance was superior (i.e., increased accuracy and decreased RT) on both Pre-stimulus Cue and Retro-Cue trials compared to No Cue trials. Experiment 2 was similar to Experiment 1, except that the retention interval was increased to 4 seconds. Similar to Experiment 1, retro-cues presented at various time points within this 4-second retention interval improved performance relative to No Cue trials. Thus, listeners were able to orient their attention to a particular sound object in STM via retro-cues, for up to 4 seconds of memory retention, thereby supporting the object-based account of auditory attention and replicating analogous retro-cue studies in vision.

A4

NEURAL CORRELATES OF DISTRACTION IN AUDITORY SCENE ANALYSIS Sebastian Pavlovic[1], Karla D. Ponjavic-Conte[1], Matthew S. Tata[1]; [1]University of Lethbridge — Selective attention is often described as the exclusion of irrelevant information in order to optimize perception of a single source of sensory input. Failure to maintain selective attention results in the familiar phenomenon of distraction. We sought to investigate the electrophysiological correlates of distraction in the auditory modality. We used an "information masking" paradigm in which participants performed an auditory discrimination task in the presence of varying levels of distraction: in a high-distraction condition, task irrelevant speech was added to the auditory scene, whereas in the low-distraction condition, the speech signal was replaced by energy-matched broad-band noise. The presence of task-irrelevant speech impaired sensi-

tivity to differentiate targets from non-targets (d'). The auditory Event-Related Potential (ERP) revealed an attenuated N1 component in the high-distraction condition. Also, at the N1 latency we found reduced inter-trial phase locking in the theta EEG band. These results suggest that distraction may act not only to attenuate a sensory-gain mechanism, but also to disrupt the temporal fidelity of responses to auditory events over a sequence of trials.

EXECUTIVE PROCESSES: Working memory

A5

DISTURBING WORKING MEMORY: REHEARSAL, IMAGERY, AND LATENCY EFFECTS FROM EXTERNAL DISTRACTORS Jessica Tomory[1], Tiffany Jantz[1], Ezequiel Morsella[1,2]; [1]San Francisco State University, [2]University of California, San Francisco — Working memory (WM) is a temporary storage system that can be perturbed systematically by external stimuli. To examine the interaction between WM processing and external stimuli, we developed two paradigms amenable to neuroimaging technologies. Study 1 (n=6) examined the effects of environmental distractors on self-produced mental imagery. Participants indicated how often they experienced mental imagery of targets (two or six digits) while distractors (digits or letters) were displayed. Preliminary results indicate imagery was a discrete event more frequently employed when participants were holding six digits in mind (M = 9.73, SE = 7.15) than when holding two digits (M = 8.00, SE = 6.74). However, due to the small sample size, results were nonsignificant, $p > .05$. Study 2 (n=27) explored the effects of external distractors on speech plans held in WM. Participants were cued to say a non-word that they were holding in WM. The cue to say the word was either identical (congruent condition) or was different (interference condition) from the non-word held in mind. Naming latencies were faster in the congruent condition than the incongruent condition, $t(26) = 3.14$, $p < .01$. Cue-induced interference arose despite the response certainty and instructions to ignore the cue identity. Systematic interference was also evident in participants' trial-by-trial self-reported 'urges to err,' $F(2,26) = 3.02$, $p = .057$. These paradigms further illuminate how WM is susceptible to external stimuli and begin to reveal the subjective aspects of WM performance. The aim of this research is to integrate these paradigms with neuroimaging technologies.

ATTENTION: Auditory

A6

EFFECTS OF EMOTIONAL VALENCE ON THE 'WHAT' AND 'WHERE' PATHWAYS OF AUDITION. James Kryklywy[1], Ewan A. Macpherson[1], Steven G. Greening[1], Derek G.V. Mitchell[1]; [1]University of Western Ontario — In a crowded sensory environment, organisms must be able to prioritize information to efficiently maintain focus and interact with critical stimuli in the environment. One characteristic known to modulate attention is the emotional nature, or valence, of the stimuli. In the visual domain, we often orient our attention toward emotional stimuli. This bias is accompanied by enhanced activity in ventral visual processing areas. In our study, we investigated whether similar effects are observed in the auditory domain. We used functional magnetic resonance imaging (fMRI) to identify the neural processes involved in localizing emotional sounds. We created a virtual auditory environment in the scanner by generating sounds based on each individual's unique head-related transfer functions. While undergoing fMRI, participants indicated the position of a sound as quickly and accurately as possible from four potential locations spanning the front horizontal plane. Enhanced activity to emotional relative to neutral sounds was observed in an area of cortex along the superior temporal gyrus, anterior to primary auditory cortex. In addition, an area posterior to primary auditory cortex, was modulated as a function of location. Conjunction analyses confirmed the spatial dissociation of these effects. These patterns of activation are consistent with the putative 'what' and 'where' auditory processing stream, and imply that the valence of auditory cues augments neural activity in the 'what' but not 'where' pathway for auditory processing.

A7

EFFECTS OF TINNITUS AND HEARING LOSS ON FUNCTIONAL BRAIN NETWORKS INVOLVED IN SHORT-TERM MEMORY Kwaku Akrofi[1], Jake Carpenter-Thompson[1], Fatima Husain[1]; [1]University of Illinois at Urbana-Champaign — Brain imaging data were acquired from two subject groups - persons with hearing loss and tinnitus (TIN) and those with normal hearing without tinnitus (NH) - to test the hypothesis that TIN and NH subjects use different functional brain networks for short-term memory. Previous studies have provided evidence of a link between hearing disorders such as tinnitus and the reorganization of functional networks including those outside of the classical auditory pathway. A deeper understanding this reorganization could lead to the development of more effective therapies and treatments for tinnitus. Data analysis was conducted on functional magnetic resonance imaging (fMRI) data obtained while subjects performed auditory short-term memory tasks with low (LO) or high (HI) attentional loads. Stimuli were pure tones with frequencies between 500 and 1000 Hz. In LO tasks, subjects determined whether two such tones which were 0.5 s apart in time were identical or not. In HI tasks, the objective was to determine whether any two of three tones, with the first two 0.5 s apart and the third one 1 s after the second one, were identical or not. Preliminary statistical analyses showed that the NH group exhibited more extensive fMRI response relative to TIN for a HI>LO t-contrast at p?0.001 (uncorrected), with notable differences in their respective patterns. The reaction times and accuracies with which subject performed the tasks did not differ significantly across the groups.

A8

IMPACTS OF SELECTIVE AUDITORY ATTENTION AND MUSICAL TRAINING ON CORTICAL RESPONSE VARIABILITY IN CHILDREN AND ADULTS Dana Strait[1], Nina Kraus[1]; [1]Northwestern University — Variability in cortical auditory-evoked responses provides a neural index of auditory attention performance in children and adults. Given that musical training exercises auditory attention, it is not surprising that adult and elementary school-aged musicians demonstrate more of an impact of attention on response variability than nonmusicians. The developmental time course for this neural index of auditory attention and how it unfolds with musical training, however, remains undetermined. Here, we compared cortical auditory-evoked variability with auditory attention in musicians and nonmusicians across three age groups: young adults, 8-12 year olds and 3-5 year olds. We aimed to determine how childhood musical training impacts this cortical index of auditory attention performance across the child lifespan and into adulthood. Results reveal decreased auditory-evoked response variability with attention in adults and older children with musical training, with more general cortical enhancements in 3-5 year old musicians. Outcomes may be considered in the context of training-dependent plasticity with musical training and are consistent with increased specialization of neural function over development.

A9

SELECTIVE ATTENTION AND THE NEURAL REPRESENTATION OF SPEECH ENVELOPES Cort Horton[1], Michael D'Zmura[1], Ramesh Srinivasan[1]; [1]University of California, Irvine — Recent studies report activity in auditory cortex that is phase-locked to the envelope of speech, but the function of this activity remains unclear. It may result from successful attention to and comprehension of speech. Alternatively, the activity may simply reflect responses to stimulus acoustics. We recorded high-density EEG while adults selectively attended to speech coming from one speaker, while ignoring speech from others. Detailed timing and topographic information about phase-locked responses were extracted by cross-correlating the time-series of both attended and unattended stimulus envelopes with the time-series of EEG channels and ICA components derived from the data. We found very low-latency phase-locked responses that encode the envelopes of both attended and unattended speech equally

well, suggesting that sub-cortical representations of speech envelopes do not depend on attention. The longer-latency, cortical responses differed considerably between attended and unattended speech. By examining the ICA components that contribute to these responses, we found two general patterns of activity. Some ICA components that phase-locked to attended speech showed attenuated or entirely absent phase-locking to unattended speech. Another class of components phase-locked to both attended and unattended speech, but the attended and unattended responses were 180 degrees out of phase. Our data suggests that mechanisms for selective attention to one of multiple speakers likely involves traditional enhancement and suppression mechanisms, as well as a modulation of the phase of endogenous activity in auditory cortex to align high-excitability periods with attended speech syllables.

A10

NEUROMAGNETIC CORRELATES OF DYNAMIC ALLOCATION OF ATTENTION TO METRICAL AND GROUPING ACCENTS IN RHYTHMIC SEQUENCES ARE MODULATED BY MUSICAL EXPERTISE Shu-Jen Kung[1], Ovid Tzeng[1,2], Daisy Hung[1,3], Chiashin Shih[1,3,4], Denise Wu[1,3]; [1]National Yang Ming University, [2]Academia Sinica, [3]National Central University, [4]National Chengchi University — When listening to music, we move in synchrony with the beat, which is inferred from accents. In our previous work (Kung et al., in press), although both musicians and non-musicians allocated attention dynamically according to metrical and grouping accents when performing a task that no explicit attention to the rhythmic pattern was required, only musicians demonstrated extraordinary sensitivity to the grouping accents when they coincided with metrical accents, suggesting that the automaticity of auditory entrainment to temporal regularity is modulated by musical training. The present study examined the neuromagnetic correlates of such dynamic allocation of attention to further verify the effect of musical expertise. Specifically, musically trained and not-trained participants listened to monotonic and isochronous sequences and were required to detect whether the occurrence of the last tone was temporally expected. The mismatch field (MMF) elicited by a deviant click, appeared in 40% of the sequences, that coincided with a metrically strong or weak beat and with or without a grouping accent within a perceptual group was recorded. The results replicated our previous findings in showing that the magnitude of MMF was modulated by metrical and grouping accents in musicians, while these effects were reduced in non-musicians. The results further suggest that auditory entrainment to temporal regularity induced by metrical and grouping accents is automatic in musicians but less so in non-musicians when participants' attention was only directed to the inter-tone interval but not to the metrical structure of a rhythm.

EMOTION & SOCIAL: Self perception

A11

ERP STUDY OF SELF-REFERENCED MOOD ADJECTIVES Szczepan Grzybowski[1], Miroslaw Wyczesany[1]; [1]Psychophysiology Lab, Jagiellonian University, Krakow, Poland — The main goal of the study was to explore the ERP differences during reading of emotional words related to the self (feelings of one's internal state). We speculated that the adjectives described as congruent with the participants' mood will be processed differently than the incongruent ones. The differences should be visible even at the early stage of word processing (pre-lexical stage) as well as at the later stages (semantic analysis). 60 adjectives were presented separately for 1 second each. They were shown during the two consecutive sessions with simultaneous mood induction by 20 highly positive or 20 highly negative pictures from the International Affective Picture System database. After each adjective presentation participants had to evaluate on a 4 point scale to what extent the word described their current mood. The results showed that the adjectives congruent with the participants' actual mood are differently processed by the brain as opposed to the incongruent ones. This was evidenced as early as 150ms (N170 component) after the stimulus offset with higher negative wave evoked to the congruent words. Later components (P3 and LPP - Late Positive Potential) were significantly more positive when evoked by the congruent adjectives. There were no noticeable effects of arousal and valence ratings of the words. The self-reference seems to be the most important factor in the processing of emotional adjectives. Since its impact is evidenced even at the early stages of word analysis it is suggested that the word processing involves synchronous lexical and semantic analyses.

A12

NEURAL REPRESENTATION OF GUILT IN EPISODIC MEMORY: AN FMRI STUDY. Carlos Makoto Miyauchi[1,3], Motoaki Sugiura[3], Yukihito Yomogida[2], Yoritaka Akimoto[3], Ryuta Kawashima[3,4]; [1]Department of Functional Brain Imaging, Tohoku University Graduate School of Medicine, Sendai, Japan., [2]Tamagawa University Brain Science Institute, Tokyo, Japan., [3]Department of Functional Brain Imaging, IDAC, Tohoku University, Sendai, Japan., [4]Smart Ageing International Research Center, IDAC, Tohoku University, Sendai, Japan. — Memory retrieval of guilty self-actions is responsible for promoting prosocial behavior yet provoking some psychopathological manifestations such as anthropophobia and depression. In this functional magnetic resonance imaging study, we used a two-by-two factorial design including emotion (emotional, non-emotional) and agent (self-action, other-action). We identified the neural representation of guilt in episodic memory by dissociating it from the neural representation of self-action in episodic memory. In the encoding task before the fMRI task, subjects experienced four conditions: stabbing a pushpin through the eye of a face picture (emotional self-action condition: ES); observing a picture with a pushpin stabbed through the eye (emotional other-action condition: EO); stabbing a pushpin through the margin (non-emotional self-action condition: NS); observing a face picture with a pushpin stabbed through the margin (non-emotional other-action condition: NO). In the fMRI task, subjects made a recognition judgment for the faces. Activation specific to guilty memory retrieval was observed in the right insular cortex as a result of the interaction of the emotion and agent [(ES-NS)-(EO-NO)]. Self-action memory retrieval activated the right putamen, posterior superior temporal sulcus (pSTS), subgenual cingulated cortex (SCC), and rostral anteriror cingulated cortex (rostral ACC) in the results from the main effect of the agent [(ES-EO)+(NS-NO)]. We suggest that the representation of guilt in episodic memory is associated with activation in the right insular cortex and that brain regions previously indicated to be the neural representation of guilt, such as the pSTS, the SCC, and the rostral ACC, might actually be self-action memory retrieval processing areas.

A13

OWNERSHIP AND ATTENTION: P300 MODULATION TO SELF-OWNED ITEMS AND OWNERSHIP CUES Philip Collard[1], David J. Turk[1]; [1]Psychology, University of Aberdeen — Information encoded in relation to self through temporary ownership benefits from an elevated memorial status. Previously we have shown that cognitive processes associated with the allocation of attention are engaged at the moment that ownership is established, and that there is a narrowing in spatial attention to the object (P300 effect to the object and reduced P1 to peripheral grating stimuli following ownership; Turk et al., 2011). In the current study we sought to determine whether these effects might also impact on perceptual processing of owned items. We recorded electrophysiological responses to the initial presentation of temporary ownership cues (self/other) and to the later presentation of objects assigned to each condition. As with previous research, self-ownership cues elicited differences in event-related brain potentials (ERPs) associated with attentional biases (P300 effect). A smaller but significant P300 effect was also observed to self-owned objects. These findings demonstrate the importance of attentional resources in the encoding of self-item associations through temporary ownership. The replication of the P300 effects and the absences of electrophysiologically measureable differences in early perceptual pro-

cessing will be discussed in relation to neural models of self and object ownership.

A14

NEURAL REPRESENTATIONS OF SELF AND OTHER: BEYOND THE DEFAULT MODE NETWORK Jonathan H. Drucker[1], Christine D. Wilson-Mendenhall[2], Lisa F. Barrett[2], Lawrence W. Barsalou[1]; [1]Emory University, [2]Northeastern University — Self-referential processing has been shown to recruit the default mode network (DMN), so-called due to its activation during the absence of effortful cognition (Northoff et al., 2006). To further specify the roles of the DMN and other brain regions in self-related processing, we considered two forms of self: the minimal self (the subject of momentary experience, independent of conceptual knowledge about oneself), and the extended self (the aggregate of self-related knowledge, providing a stable identity through time; Damasio, 1999; Gallagher, 2000). Using fMRI, we distinguished these two forms of self in the human brain, and explored the possibility that representations of other people and objects obey this distinction as well. In each trial, participants received the name of an individual (the self, a non-self human, or a non-human object) followed by a property, and then rated how well the property applied to the individual. Four principal findings emerged: 1) A conjunction of the three individual conditions revealed an "identity network" (IDN) that excluded the DMN. We propose that the IDN instantiates minimal representations of individuals in general, not just of the self. 2) Regions immediately adjacent to the IDN differentiated between individuals along a gradient of self-relatedness. 3) A conjunction of the property conditions revealed activations of the IDN and the DMN, with the latter only occurring for human individuals, perhaps binding representations of people with their traits. 4) Activation in the DMN correlated strongly with self-relatedness, implying a graded distinction between self, other, and object in this neural circuit.

A15

P300 AMPLITUDE DIFFERENCES BETWEEN HETEROSEXUAL AND HOMOSEXUAL FEMALES DURING A SELF-AWARENESS TASK Joel Alexander[1], Ronald Alexander[2]; [1]Western Oregon University, [2]Wartburg College — Studies (Alexander et. al 2005; Alexander et. al 2011) have indicated that P300 amplitude is higher during a self awareness task in which the subject assesses whether or not she is surprised by the occurrence of a target tone in sequence of tones presented. It has been suggested that this increase in P300 amplitude during a self awareness task represents an increase in utilization of cognitive resources compared to other cognitive tasks. To examine if this finding is robust to varying personal factors we utilized a population of females who differed in sexual orientation (heterosexual, homosexual). The P300 event-related potential (ERP) was recorded in 30 (15 heterosexual 15 homosexual) female subjects during routine auditory sensory discrimination task, a matched cognitive, and a matched self-awareness task. Similar to previous studies the P300 amplitude was found to be higher during the self-awareness task compared to the standard discrimination task across all electrode locations. Homosexual females were found to have consistently higher P300 amplitude compared to heterosexual females across all three tasks. No significant interactions were found in analysis between task and sexual orientation. These findings indicate that the self-awareness task is robust to the variation of sexual orientation between subjects and that homosexual females have higher P300 amplitude across tasks.

A16

THE NEUROSCIENCE OF ACTING Lauren Kutcher[1], Steven Brown[1]; [1]McMaster University — The current study represents a first attempt to look at the neural basis of acting. Every person plays multiple roles in daily life – for example "friend", "student" or "employee" – where these roles are all facets of the "self" or first-person (1P) perspective. Compared to such everyday role-playing, actors are required to portray other characters and to adopt the thoughts and emotions of these people. Consequently, actors must think and feel not as themselves but as the characters they are portraying, thereby assuming a "fictional first-person" (fic-1P) perspective. Utilizing functional magnetic resonance imaging, we sought to identify brain regions preferentially activated when actors adopt a fic-1P perspective during role playing (pretense). In the scanner, trained actors responded to a series of conditional questions from either their own 1P perspective or from that of Romeo (male subjects) or Juliet (female subjects) from Shakespeare's drama. Compared with the 1P condition, fic-1P elicited changes in the cortical midline network, including the ventromedial prefrontal cortex, precuneus, and posterior cingulate cortex. Thus, role playing during acting seems to be a departure from standard self-processing. This study represents a first step towards elucidating the neural basis of acting.

A17

ERP CORRELATES OF THE SELF-POSITIVITY BIAS Esther Fujiwara[1,2], Melanie Alpaugh[2,3], Nick Brownoff[3], Anthony Singhal[2,3]; [1]Department of Psychiatry, University of Alberta, [2]Centre for Neuroscience, University of Alberta, [3]Department of Psychology, University of Alberta — One of the most robust findings in social psychology is the self-positivity bias, a tendency of individuals to attribute more positive than negative traits to themselves. Previous fMRI and ERP studies have investigated this phenomenon by contrasting brain activity associated with favourable self-judgements (negative-not-self-relevant NNSR, positive-self-relevant PSR) versus non-favourable self-judgements (negative-self-relevant NSR, positive-not-self-relevant PNSR). However, this contrast consists of vastly different numbers of items (non-favourable< favourable). Furthermore, although both NSR and PNSR can both be considered unfavourable, endorsing negative traits as self-characteristic likely involves quite distinct mechanisms (e.g., avoid-approach tendencies) compared to rejecting positive traits. In our EEG/ERP experiment, we set out to test if previously reported (Watkins, et al., 2007) larger fronto-central N400 ERPs to one or both types of unfavourable self-related information could be replicated by randomly selecting identical trial numbers from each of four conditions (NSR, PNSR, NNSR, PSR). High density EEG/ERP data were recorded while 28 participants judged positive and negative trait adjectives. We found a robust self-positivity bias behaviourally. In EEG/ERP, the N400 was larger only for negative self-relevant (NSR) words, compared to all three other conditions. This result was most pronounced over temporo-parietal electrodes (T7, TP9). The lateral temporal rather than fronto-central topography of the larger N400 in NSR judgements more strongly resembles semantic than affective incongruency detection in our task. Selectively finding larger N400 ERPs to NSR, but not PNSR, implies a functional difference between these two types of unfavourable self-judgements.

A18

STRUCTURAL CONNECTIVITY OF MEDIAL PREFRONTAL CORTEX AND NUCLEUS ACCUMBENS PREDICTS TRAIT SELF-ESTEEM. Robert S. Chavez[1], Katherine E. Powers[1], Todd F. Heatherton[1]; [1]Dartmouth College — Though several brain areas have been shown to be involved in the neural representation of self and others, the medial prefrontal cortex (MPFC) is the region most consistently implicated in these processes. In particular, there is evidence that ventral MPFC is more often implicated in coding of self-referential thought, whereas dorsal MPFC seems to code for the representation of others. Self-esteem is an evaluative attitude based on the extent to which a person views themself as favorable and leads them respond to their social world. By definition, individuals with high self-esteem tend to think of themselves with elevated regard, but little work has been to investigate the underlying neural networks that give rise to these attitudes. In the current study, we used diffusion tensor imaging and probabilistic tractography to investigate whether individual differences in the structural connectivity of MPCF and nucleus accumbens (NAcc; a putative reward area) would be related to a trait-level measure of self-esteem. Because of the self-relevant nature of self-esteem, we hypothesized self-esteem would be related to greater connectivity of NAcc to ventral MPFC, but not dorsal MPFC. In a sample of 75 normal subjects, we found a positive relationship between left-NAcc /ventral-MPFC connectivity and self-esteem. As hypothesized, there were no sig-

nificant results for the dorsal portion of MPFC. These results provide evidence that connectivity of brain regions involved in processing self-relevant cognition to reward-related areas contribute to individual differences in trait self-esteem.

A19

NEURAL BASIS OF SELF-CONTINGENCY DETECTION IN 5-MONTH-OLD BABIES Gecia Hermsdorff[1,2,4], Iris Trinkler[3,4], Luca Filippin[1], Michel Dutat[1], Emmanuel Dupoux[1,3]; [1]Laboratoire de Sciences Cognitives et Psycholinguistiques, Département d'Etudes Cognitives, ENS, Paris, France, [2]Virginia Tech Carilion Research Institute, Human Neuroimaging Laboratory, Virginia Tech, [3]Inserm U955 E01, Département d'Etudes Cognitives, ENS, Paris, France, [4]Both authors contributed equally to this work. — Self-knowledge is ipso facto the essential piece for the phenomenological existence of the individual. Self-knowledge is grounded on a basic embodied sense of self that, in turn, relies on "self-contingency" detection, which is the ability to match sensory feedback received during a movement with internal motor and sensory representations. In order to understand the cognitive and neural mechanisms that are essential to self-knowledge, we seek to identify the cognitive and neural mechanism involved in self-contingency detection in 5-month-old babies using functional Near-infrared spectroscopy (NIRS). We measured babies' neural activations in a contingent condition, in which babies watched an online video of their own legs and in a non-contingent condition in which they watched the video of another baby's legs. We further presented a sound at a volume that was proportional to the quantity of legs' movement at the screen and measured babies' legs movement. Moreover, we measured baby's looking preferences when these two videos were presented at the same time. Our behavioral results replicate the previous findings that infants can discriminate between the contingent and non-contingent situation. They spent significantly more time looking to the non-contingent videos. Preliminary analyses suggest that self-contingency detection is not an automatic process: it involves a learning mechanism and babies' emotional expressions correlate with self-contingency detection. The neural results indicate that somatosensory cortices are recruited both when babies watched their own legs and another baby's legs. Moreover, as would be expected from the adult neuroimaging literature, the parietal cortex is specifically involved in self-contingency detection.

A20

INSULA CORTEX ACTIVITY DURING TWO SELF-RELATED CONDITIONS Helder F. Araujo[1,2,3], Jonas Kaplan[1], Hanna Damasio[1], Antonio Damasio; [1]Brain and Creativity Institute, University of Southern California, [2]Neuroscience Graduate Program, University of Southern California, [3]Graduate Program in Areas Basic and Applied Biology, University of Oporto, Portugal — It has been established that insular cortex maps represent aspects of the body and participate in bodily and emotional feelings processes. On the assumption that the self is grounded in body representations, we hypothesize that the insula is involved in self-related processes. Using fMRI, we investigated insular involvement in two domains of autobiographical self: personal traits and biographical facts. Nineteen participants answered questions about (a) their own traits; (b) their factual biographies; (c) the traits of an acquaintance; and (d) the factual biography of an acquaintance (4 conditions). The subjects completed three functional scans. Each scan included three 24-second blocks of each condition and blocks of one-back-task as an active baseline. After scanning, participants answered additional questionnaires. Image analysis was performed with FSL. Insula activity during "self" conditions was not different from that observed during "other" conditions, but was greater during "traits" than during "facts". The difference between "self" and "other" in insula activity correlated negatively with time of acquaintanceship (T) and with perspective taking scores; the difference between "traits" and "facts" in insula activity correlated positively with body-awareness scores; and insula activity related to traits of others correlated negatively with subjects' ratings on how well those traits described their acquaintances, but positively with T. The insula appears to be involved in processing both self and non-self biographic information. In addition, its involvement in processing non-self biographic information seems to depend on features of the subjects' personality and on aspects of the relationship between the subjects and their acquaintances.

A21

FMRI STUDY OF SELF VS. OTHERS' ATTRIBUTIONS OF TRAITS CONSISTENT WITH EVOLUTIONARY UNDERSTANDING OF THE SELF Gonzalo Munevar[1], Matthew Cole[1], Yongquan Ye[2], Jie Yang[2], Mark Haacke[2]; [1]Psychology Program, Lawrence Technological University, [2]MR Research Facility, Wayne State University — Our fMRI study on self-attribution aims to test an evolutionary explanation concerning the neural substrates of the self. From an evolutionary perspective a complex brain should: (1) coordinate new sensory information in light of the organisms' internal states and in the context of its personal history and genetic inheritance — so it can use previous experience and learn; (2) it would thus constitute a distributed self. We compared three general conditions of self vs. other trait attributions: Self, Best Friend, and Bill Gates. Each of these conditions were comprised of two additional conditions: Personality Traits and Non-Personality Traits. Thirteen participants (6 females, age: 18-57) rated a series of 90 personality and non-personality trait adjectives as to whether they applied to themselves or others, in a block-design paradigm. Data were acquired using a 3 Tesla Siemens Verio scanner at Wayne State University, and analyzed using SPM8. We hypothesized that in comparing Self vs. other conditions we should find differential activation suggestive of (a) preparedness for action/motion and reward (basal ganglia), (b) overlap of Self-Best Friend condition with structures that permit allometric (non-geocentric) orientation and perspective (basic to an animal), (c) and similarity of contrast between Self- Bill Gates and Best Friend-Bill Gates, with greater activation in the former, which would account for the finding by others of involvement of MPFC in attributions to self and close others. We found significant activation as follows: (a) substantia nigra and the caudate nucleus (right), (b) rBA31, and (c) lBA24.

EXECUTIVE PROCESSES: Goal maintenance & switching

A22

SWITCHING STRATEGY UNDERLIES VERBAL FLUENCY IMPAIRMENT IN OBSESSIVE-COMPULSIVE DISORDER Ye Seul Shin[1], Na Young Shin[1], Joon Hwan Jang[2], Geumsook Shim[2], Hye Yoon Park[2], Min-Sup Shin[2], Jun Soo Kwon[1,2]; [1]Seoul National University, Seoul, Korea, [2]Seoul National University College of Medicine, Seoul, Korea — Previous studies have reported verbal fluency impairment in obsessive-compulsive disorder (OCD), but no study has evaluated the cognitive processes underlying verbal fluency in OCD. In the present study, we sought to test the hypothesis that verbal fluency impairment in OCD resulted from switching problems rather than lack of verbal ability per se. In addition, we examined the relationship between the symptom dimensions of OCD and verbal fluency to better understand OCD heterogeneity. The study included 85 patients with OCD (45 drug-naïve and 40 drug-free) and 71 healthy controls matched for gender, age, education, and intelligence. The Controlled Oral Word Association (COWA) test was administered to assess verbal fluency and switching performance. Patients with OCD generated a smaller number of words and displayed fewer switches than did healthy control subjects. Furthermore, switching was found to mediate impaired verbal fluency in OCD. Impairment in switching and verbal fluency was related to the symmetry dimension in patients with OCD. Our findings suggest that verbal fluency impairment in OCD is mediated by a switching deficit that may originate from abnormal processing in the frontal-striatal circuitry involving the orbitofrontal cortex. Moreover, impaired verbal fluency in OCD may be modulated by distinct obsessive-compulsive dimensions.

A23

BLINK PREDICTS ENHANCED COGNITIVE CONTROL Marlies E. van Bochove[1], Lise Van der Haegen[1], Wim Notebaert[1], Tom Verguts[1]; [1]Ghent University — Although much of our behavior is driven by routines, when the situation changes we are able to overcome our routines in favor of a more appropriate response. This is referred to as cognitive control. One classical index of cognitive control is the Gratton effect (Gratton et al., 1992) which is identified as an interaction between congruency on the current trial and congruency on the previous trial. Recently, it was suggested that cognitive control is implemented by successful binding between stimuli and actions (Verguts & Notebaert, 2009). Several neuromodulators are suggested to enhance binding, among which dopamine (DA; Silvetti, Seurinck & Verguts, 2011) and norepinephrine (NE; Verguts & Notebaert, 2008, 2009). The current study investigated measures related to both neuromodulators in cognitive control. We asked 48 participants to complete a flanker task, during which their pupil dilation (related to NE; Nieuwenhuis & Jepma, 2011) and eye blinks (related to DA; Blin et al., 1990; Taylor et al., 1999) were recorded. We applied hierarchical linear modeling (HLM) and found a significant three-way interaction between congruency on the current trial, congruency on the previous trial, and blink on the previous trial, which indicates a larger Gratton effect after blink trials compared to no blink trials. This shows that cognitive control is enhanced following blink trials, suggesting a role for DA in binding and in cognitive control.

A24

FRONTO-PARIETAL REPRESENTATION OF SEQUENTIAL TASKS ausaf farooqui[1], John Duncan[1]; [1]MRC-Cognition & Brain Sciences Unit, Cambridge, UK — Fronto-Parietal regions have been shown to represent all kinds of task relevant events. However, in real behaviour task relevant events occur in the context of temporally extended, multistep, sequential task episodes. It is not known whether the representation of task elements is affected by their ordinal position in the sequence. In an FMRI experiment, we looked at the representational profile of two kinds of trial blocks. In the organised blocks, subjects executed a list of sequential tasks, such that the consecutive trials of such blocks were sequential steps towards a common goal. Further, this list of tasks was to be kept in working memory (WM) and its elements were sequentially discarded as the corresponding task was executed, causing a stepwise decrease in this load. In the unorganised blocks, component trials were independent of each other and there was no list to be executed; subjects were informed before every trial about the task to be done. However, in terms of the actual task done, the two blocks were identical. Activity in many fronto-parietal regions and the information content of the elicited pattern of activity increased sequentially across the trials of the organised blocks, in spite of a concomitant decrease in WM load. Interestingly, this pattern of increasing activity was seen in regions from both cognitive control and default mode networks. Fronto-parietal results were weaker in the unorganised blocks. Our results thus show that the context of the task episode strongly determines the neural representation of the task elements.

A25

THE EFFECT OF RESOURCE-LIMITED AND DATA-LIMITED TASKS ON SUSTAINED BOLD ACTIVITY Joseph Dubis[1], Joshua Siegel[1], Steven Petersen[1]; [1]Washington University in St. Louis — The human brain is capable of performing numerous tasks, including novel and difficult tasks of many forms, with relative ease. In 1975, Norman and Bobrow proposed a dichotomy of task types, depending on whether performance is limited by demands on the organization on attentional resources, or is limited by the data provided by the stimulus. Research by Dosenbach et al. (2006) identified brain regions showing task control signals—task initiation, error-related feedback, and task maintenance—across tasks. It appeared, based on post-hoc analyses, that task maintenance signals were weaker when the difficulty of the task was driven by data limitations. Here, we test whether task maintenance regions respond differently to data-limited and resource-limited tasks using a mixed block/event-related fMRI design. We compared three tasks—resource-limited noun:verb and mental rotation judgments and a data-limited dot pattern coherence judgment. Behaviorally, the noun:verb task was easier than the other two tasks, both objectively (accuracy and reaction time) and subjectively (post-test questionnaire). On the other hand, task maintenance signals in cingulate and insula regions were greater for the resource-limited noun:verb and mental rotation tasks than the data-limited task. This finding indicates the putative task maintenance signals reflect the organization of attentional resources. This is true for orgainzing perceptual and imagery processes in the rotation task and verbal processes in the noun:verb task. This finding also shows the sustained BOLD signal is not related to task difficulty or arousal, as has been proposed.

A26

PUPILLOMETRY REVEALS CHANGES IN COGNITIVE CONTROL DYNAMICS AS A FUNCTION OF MOTIVATIONAL INCENTIVES Kimberly S. Chiew[1], Renaldo Gacad[1], Todd S. Braver[1]; [1]Washington University in St. Louis — Behavioural and neural evidence suggests that motivational incentives can influence cognitive performance through enhancement of proactive control processes. The present study examines the influence of reward on cognitive control dynamics in the AX-Continuous Performance Task (AX-CPT), a cue-probe task permitting relative characterization of proactive and reactive control processes, using task performance and high-resolution pupillometry (as a performance-independent measure of mental effort). Changes in task performance were consistent with the idea that incentive is associated with a shift to relatively more proactive control. This shift was also reflected in pupil dilation, which increased in incentive relative to non-incentive trials. Importantly, this increase in dilation occurred during active maintenance of cue information, where it may be interpreted as reflecting enhancement of proactive control processing. We also observed incentive-related changes in pupil constriction when perceptual factors were controlled, suggesting that constriction may be a novel marker of affective influences on cognition as well as reflexively indexing changes in luminosity. Although incentive trials and faster RTs were both associated with greater pupil dilation, the two effects could be dissociated: incentive effects on pupil dilation were present even when comparing RT-matched trials. Pupillometry may thus provide a useful, performance-independent measure by which to examine dynamic shifts in cognitive control as well as indexing changes in motivation separate from cognitive demands.

A27

CROSS-CORRELATION DYNAMICS OF FRONTO-PARIETAL NETWORKS DURING RESPONSE MODE SWITCHING: AN EVENT-RELATED OPTICAL SIGNAL (EROS) STUDY Pauline L. Baniqued[1], Kathy A. Low[1], Monica Fabiani[1], Gabriele Gratton[1]; [1]University of Illinois at Urbana-Champaign — Coordination between networks of brain regions is important for optimal cognitive performance, especially in attention demanding tasks. Functional connectivity is widely studied by assessing the temporal correlation of the fMRI BOLD signal in distinct regions over time. With the event-related optical signal (EROS), we can better characterize the rapidly evolving network processes that occur. EROS measures changes in optical scattering due to neuronal activity and offers good spatial and temporal resolution. With EROS, we investigated network dynamics during the preparatory period of a response-mode switching task. We used lagged cross-correlations to study the interactions between switch-related attentional control and response preparation processes. On each trial, participants received an auditory-visual precue indicating whether to respond vocally or manually. Participants then saw or heard the letter "L" or "R", indicating a "left" or "right" response to be implemented with the appropriate response modality. We observed accuracy switch costs, but no reliable reaction time switch costs. We found common switching activity in fronto-parietal regions beginning around 200 ms post-precue, and modality-specific modulation of motor cortex during switch trials. Seeded cross-correlations revealed coupling of right frontal cortex to motor cortex for manual-switch trials, and right frontal coupling to left-lateralized regions for vocal-switch trials, with modality-

specific activations peaking at 50-150 ms lags from right frontal activity. These results provide a more comprehensive picture of millisecond-scale network interactions that flexibly adapt to task demands. Monitoring these online processes can inform applications to augment cognition such as by providing feedback to prevent errors in complex tasks.

A28

USING TRANSCRANIAL MAGNETIC STIMULATION TO ASSESS CERTAINTY AND REWARD MODULATION OF THE PRIMARY MOTOR CORTEX

Eric Mooshagian[1,2,3], Aysha Keisler[1,2], Trelawny Zimmermann[1,2], Eric Wassermann[1]; [1]National Institute of Neurological Disorders and Stroke, NIH, [2]Henry Jackson Foundation, [3]Washington University — Primary motor cortex (M1) is critical for motor learning and response selection, processes which depend, in part, on feedback and reward signals. It is also established that primate M1 receives a robust, direct dopaminergic projection, which produces cortical inhibition. Though human reward circuits are integral to learning, their influence on M1 activity is still poorly understood. Recent transcranial magnetic stimulation (TMS) studies demonstrated reward-related changes in motor evoked potentials (MEPs) across varying reward conditions and attributed the modulation to differences in reward expectation. There are multiple components of reward signals, however, including the expected reward value or the degree of uncertainty, i.e., the extent to which an outcome is known. Uncertainty is related to expected reward value: It is maximal when the probability is 0.5 (i.e., chance), and minimal when it is 0 or 1 (i.e., certain outcome). These outcomes often covaried in previous studies. Here, we sought to determine whether reward-related MEP changes in M1 reflect reward probability or uncertainty. We applied paired-pulse TMS and measured intracortical inhibition in subjects while they made choices in order to find or avoid a hidden cue. The probability of success was 0, 0.5, or 1. Successful trials were rewarded with 25 cents. TMS occurred 250 ms after stimulus onset, and before the choice was made or feedback given. Results suggest that the psychological context modulates the magnitude of inhibitory reward signals in M1 and that, at our early stimulation time, the MEP is sensitive to expected reward value.

A29

CORTICAL ACTIVATION CHANGES WITH PERFORMANCE FLUCTUATIONS ON A SUSTAINED ATTENTION TASK

Jayde Nail[1], Hillary Schwarb[1], Zain Sultan[1], Andy McKinley[2], Lloyd Tripp[2], Shella Kielholz[1], Eric Schumacher[1]; [1]Georgia Institute of Technology, [2]Air Force Research Laboratory — Research of the neural mechanisms underlying sustained attention is critical if we are to understand and avoid situations where failures to sustain attention can be devastating. Recent research using the psychomotor vigilance task (PVT) as a measure of sustained attention has implicated prefrontal and parietal brain regions (Drummond, et al, 2005). Activity patterns in the default mode network have also been shown to predict successful target detection in the PVT (Drummond, et al., 2005). Neither of these studies have investigated how the neural mechanisms underlying performance in the PVT change over an extended period of time. The goal of the current study was to identify the neural correlates of sustained attention across a longer period of time than has been investigated previously. Participants performed a PVT while undergoing fMRI without a break for 30 minutes. Participant performance decreased over the session. This decrease in activity was associated with changes in activity in dorsolateral prefrontal, inferior parietal, primary and secondary occipital cortices, and the basal ganglia. These results identify the neural correlates with failures of sustained attention over performance timescales associated with real world attention tasks (e.g., air traffic control, radar operators, image analysis, etc.).

A30

PREDICTING THE RESPONSE OF PATIENTS WITH BRAIN INJURY TO COGNITIVE REHABILITATION: EVIDENCE FROM ANALYSES OF FUNCTIONAL BRAIN NETWORKS

Katelyn L Begany[1,2], Emi M Nomura[2], Caterina Gratton[2], Anthony J.-W. Chen[1,2,3,4], Tatjana Novakovic-Agopian[1,3,4,5], Mark D'Esposito[1,2]; [1]Veteran's Administration Northern California Health Care System, Martinez, [2]University of California, Berkeley, [3]Veteran's Administration Medical Center, San Francisco, [4]University of California, San Francisco, [5]California Pacific Medical Center, San Francisco — Anatomical brain structure does not fully predict the susceptibility of patients with brain injuries to long-term executive dysfunction or individual variability in response to rehabilitation interventions. Understanding the neural mechanisms of recovery of function is not only of clinical importance, but critical for cognitive neuroscience studies which traditionally use the lesion method as a tool for understanding brain-behavior relationships. Reorganization of functional networks after brain injury is likely an important mechanism of recovery, particularly for high-level cognitive processes supported by interactions between brain regions. We investigated the neural bases of individual differences in plasticity after brain injury by examining the relation of modularity, a measure of functional network organization, to improvement after an experimental rehabilitation intervention. Patients (n=11) were trained in a 5-week protocol for improving goal-oriented attention self-regulation. Before and after training 5 minutes of resting fMRI data was collected where patients were instructed to focus on relaxed breathing. A thresholded connectivity matrix of time-series correlations amongst 90 AAL atlas regions was used to generate a graph that was parcellated in separate functional networks by optimizing Newman's Modularity (a measure of the strength of within- compared to between-network connections). Baseline measurements of modularity predicted degree of recovery of executive function after clinical intervention ($r=0.775$, $p=0.005$). This suggests that more modular functional network organization predicts a patient's response to attention and executive control training. Graph theoretical analyses may provide critical tools for understanding individual variability in plasticity and may yield clinically-relevant biomarkers to guide rehabilitation efforts.

A31

STATE SWITCHING IN PSYCHOPATHOLOGY USING A HIDDEN MARKOV MODEL

Edward Patzelt[1], Zeb Kurth-Nelson[1], Nancy Raymond[1], Sheila Specker[1], Kelvin Lim[1], Angus MacDonald[1]; [1]University of Minnesota — Cognitive learning tasks, such as reversal learning, provide mechanistic insight into the dysfunction underlying addiction and other disorders of impulsivity. Here we administered a probabilistic reversal learning task to 49 cocaine addicted participants, 40 cocaine controls, 27 binge eating disordered participants, 22 overweight controls, and 21 normal weight controls. Recently, computational modeling techniques such as temporal difference learning (TD) have been used to explore the mechanisms of cognitive processing in these tasks. TD represents causal beliefs as stable structures over which a value estimate will converge with repeated experience. However, a central feature of reversal learning is rapidly changing reward contingencies. Human subjects are able to adroitly respond to these changes, suggesting that TD is not an adequate description of the decision process on this task. We therefore used a two-state Hidden Markov Model (HMM) to model subjects' behavior on our task. The model was fit to each subject's choice sequence by varying one free parameter, the symmetric transition probability of the HMM. The model improved prediction of choice compared to chance for 88% of participants. Cocaine users showed a significantly higher transition probability ($p = .024$; Mann-Whitney Wilcoxon) than cocaine controls. Binge eating disordered participants did not show any difference from overweight or normal weight controls. These results suggest that excessive switching, rather than perseveration, is the fundamental deficit in cocaine users on reversal learning tasks. This approach allows us to explain the variation between cocaine users and controls as a difference in cognitive inference processes.

A32

NEURAL NETWORKS INVOLVED IN TASK SWITCHING PERFORMANCE Paul Metzak[1,2], Susan Kuo[1,2], Todd Woodward[1,2]; [1]University of British Columbia, [2]BC Mental Health and Addictions Research Institute — In the present study, we sought to investigate the neural networks that underlie cognitive control using a task switching paradigm that involved making judgments about the colour of symbols, parity of numbers, and case of letters. In order to assess how performance is related to brain activity, performance on each trial was coded as fast, medium, or slow based on response time. Using fMRI-CPCA (http://www.nitrc.org/projects/fmricpca/), this performance information was entered into the design matrix and two components were extracted. These two components revealed patterns of brain activity that overlapped substantially with the task positive and task negative (default mode) networks. The 'task positive' component included activations in dorsal anterior cingulate cortex, primary motor regions, and inferior parietal cortex. The task negative component included deactivations in medial prefrontal cortices, and precuneus. Furthermore, it was found that these networks appear to be playing differential roles in performance such that the component reflecting the task positive network showed increased activity during slow trials, whereas the component reflecting the task negative (default mode) network was most strongly deactivated during fast/medium trials. These results suggest these two networks play different roles in optimizing performance during cognitive control.

A33

THE BIVALENCY EFFECT IN TASK SWITCHING: EVENT-RELATED POTENTIALS AND THE INFLUENCE OF UNEXPECTED STIMULUS FEATURES John Grundy[1], Miriam Benarroch[1], Sandra Monteiro[1], Judith Shedden[1]; [1]McMaster University — During task-switching, if we occasionally encounter stimuli that cue more than one task (i.e. bivalent stimuli), response slowing is observed on all univalent trials within that block. This observation is known as the bivalency effect. Here, we explore the bivalency effect by examining both event-related potentials (ERPs) and task stimulus features involved in producing the effect. In the first experiment, participants alternated between three simple tasks in six experimental blocks, with bivalent stimuli appearing occasionally in bivalent blocks (blocks 2, 4, and 6). Frontal electrode sites captured significant amplitude differences associated with the bivalency effect within time windows 100-120 ms, 375-450ms, and 500-550ms, which may reflect additional extraction of visual features present in bivalent stimuli (100-120 ms) and suppression of processing carried over from irrelevant cues (375-450 ms and 500-550 ms). Our results support previous fMRI findings (Woodward et al., 2008) and provide additional behavioural and electrophysiological evidence for the dissipation of the bivalency effect with extended practice. Another series of experiments examined the influence of unexpected stimulus features in producing the bivalency effect. Results indicate that both bivalence and unexpectedness contribute to the block-wise response slowing. These findings are discussed in relation to the differential processing involved in a controlled response style.

A34

VARIATIONS IN EARLY EXPERIENCE ARE ASSOCIATED WITH PREFRONTAL COGNITIVE CONTROL Raquel Gabbitas[1], Ruskin Hunt[1], Megan Gunnar[1], Kathleen Thomas[1]; [1]Institute of Child Development, University of Minnesota — Children in institutional care experience mild to severe deprivation as a result of inadequate care and cognitive stimulation (Rutter, 1981). Cognitive delays persist to varying degrees after removal from institutional conditions (Johnson, 2001). Age at adoption may moderate the relationship between early adversity and later cognitive outcomes. The current study examined the role of duration of institutional care in behavioral and brain measures of cognitive control in post-institutionalized (PI) adolescents and an SES-matched control group. Eighty-five PI youth (42 Early Adopted (EA) and 43 Later Adopted (LA)) and seventeen controls between 12-14 years of age were included. A motor remapping task was administered during fMRI scanning (Casey et al., 2002). Compatible (easy) trials matched numbers to fingers in an intuitive pairing. Incompatible (difficult) trials matched numbers to fingers in a less intuitive pairing. Images were collected on a Siemens 3T Trio scanner (34 slices, 4mm thick). BrainVoyager software and GLM models were employed in analyzing functional data. In the difficult condition, controls and EA youth performed similarly to each other, and LA youth showed lower accuracy. For difficult trials, greater activity in the left middle frontal gyrus (BA 46) was observed in PI youth compared to controls; EA youth also recruited the left superior frontal gyrus (BA 6) and the left superior temporal gyrus (BA 22) compared to controls. More time in an institution lead to greater performance decrements. Behaviorally, EA youth were not different from controls. However, additional neural regions were recruited by EA youth compared to controls.

A35

TOP-DOWN CONTROL OF EXTERNAL ATTENTION AND INTERNALLY-DIRECTED THOUGHT Jessica Andrews-Hanna[1], Jeremy Reynolds[2], Joseph Orr[1], Marie Banich[1,3]; [1]University of Colorado at Boulder, [2]University of Denver, [3]University of Colorado at Denver — A wealth of neuroimaging and neuropsychological research suggests distinct large-scale brain systems support externally- and internally-oriented modes of cognition. The "dorsal attention system" (DAS) becomes engaged when individuals attend to visual stimuli and spatial locations, whereas the "default network" (DN) activates when individuals reflect on their past, their future, and the minds of other people. Though growing progress has been made towards understanding the functions of these brain systems, little is known about whether they are regulated by similar or disparate top-down control mechanisms. The present study explored these questions using fMRI and behavioral approaches in the context of a task-switching paradigm. Holding stimuli constant, participants switched between two externally-oriented tasks (color, position), between two internally-oriented tasks (memory, self-descriptiveness), and between externally- and internally-oriented tasks. To isolate areas involved in task switching, switch blocks were compared to "repeat" blocks in which participants performed a single task. Importantly, the DAS was engaged to a greater degree when participants made externally-oriented judgments, whereas the DN was more engaged when participants made internally-oriented judgments. When switch blocks were compared to repeat blocks separately for external and internal tasks, a common set of frontoparietal regions was observed. However, the left anterior and inferior prefrontal cortex was activated to a greater degree when switching between two internal tasks than between two external tasks. Minimal additional differences were observed when participants switched between external and internal tasks. These results further clarify the role of the prefrontal cortex in regulation of externally- and internally-oriented modes of cognition.

A36

INTRINSIC CONNECTIVITY NETWORKS UNDERLYING CONTEXT PROCESSING DEFICITS IN SCHIZOPHRENIA Andrew Poppe[1], Deanna Barch[2], Cameron Carter[3], James Gold[4], Daniel Ragland[3], Steve Silverstein[5], Angus MacDonald[1]; [1]University of Minnesota, [2]Washington University, [3]University of California - Davis, [4]University of Maryland, [5]University of Medicine and Dentistry of New Jersey — Context processing (CP) refers to the ability to represent and maintain goal-relevant information during the execution of a task. It has been shown that schizophrenia patients demonstrate deficits in their ability to perform tasks which require CP. Impaired functional connectivity has been hypothesized as a potential source of the cognitive deficits routinely observed in patients with schizophrenia. The goal of the current study was to determine what functional connectivity networks emerge as differentially active between schizophrenia patients and healthy controls. We employed group independent component analysis (ICA) to test the hypothesis that functional connectivity differences would emerge that are associated with CP. Twelve subjects with schizophrenia and twelve healthy controls were

recruited and scanned as part of a larger, multisite study using fMRI while performing a CP task, the dot probe expectancy task (DPX). Patients performed significantly worse on the DPX task compared with controls. Additionally, the group ICA analysis revealed multiple functional networks whose time courses were correlated with the DPX task goal maintenance demands and two networks that correlated with good task performance in patients. One such network involves bilateral dorsolateral prefrontal cortex (dlPFC). The networks extracted from these data correlated highly with networks resulting from a meta-analysis of fMRI studies. These results show that functional connectivity differences underlie CP deficits in schizophrenia and point to dlPFC as an important brain region involved in these connectivity networks.

A37

EFFECTS OF TASK DEMANDS ON TASK-RELEVANT CODING IN MD REGIONS Apoorva Bhandari[1], John Duncan[1]; [1]Medical Research Council, Cognition and Brain Sciences Unit, University of Cambridge — It has been proposed that neurons in discrete regions in fronto-parietal cortex adaptively code information relevant to the task at hand. These 'multiple demand' (MD) regions are reliably activated in a variety of demanding tasks, irrespective of the specific cognitive operations involved, suggesting their role as a general purpose resource. We examined how coding of task information in MD regions changes in the face of different task demands. In a control condition, subjects classified pictures of birds into one of two categories based on their physical features. In our first manipulation, pictures were degraded by adding noise, thus introducing perceptual uncertainty. To solve the task, subjects had to devote more attentional resources for detecting relevant features. In a second manipulation, subjects switched between two tasks, using two orthogonal but conflicting boundaries to classify the pictures, thus introducing uncertainty about which rule to apply on a given trial. Here subjects had to devote more attentional resources towards detecting the relevant rule (signalled by a colour cue). We examined coding of category information in MD regions with multi-voxel pattern analysis (MVPA) using support vector machines and leave-one-out cross-generalisation. We found that introducing perceptual uncertainty led to voxel activity patterns in MD regions reflecting more information about stimulus category compared to the control condition. Introducing rule uncertainty, however, failed to modulate category information. Instead, the voxel activity patterns reflected information about the relevant rule on the trial. Our results provide evidence for adaptive coding in MD regions with changing task demands.

A38

MEDIAL FRONTAL CORTEX-BASAL GANGLIA LOOPS REGULATE TASK AND RESPONSE SELECTION Franziska M. Korb[1], Tobias Egner[1]; [1]Duke University — Adaptive behavior requires the ability to flexibly select task-sets and responses in line with changing demands. Much work has focused on investigating the implementation of 1st-order task-switches, but recent behavioral data suggest these switch processes are conditioned on higher-order task and response transitions (Brown et al., 2007, Cogn. Psychol.). Here, we paired functional magnetic resonance imaging (fMRI) with a cued task-switching protocol to assess the neural mechanisms giving rise to these effects. Behaviorally, we found that both task- and response-switch costs were dependent on the previous trial transition, whereby consecutive repetitions and consecutive switches facilitated performance relative to switch-repeat and repeat-switch transitions. These data suggest that task-set and response configurations are, by default, adapted to reflect the most recent transition demands (rather than the most recent task demands); when these demands are not replicated, control has to be engaged to overcome these settings, resulting in a behavioral cost. The fMRI data showed that this control cost maps onto activity in the preSMA for task-level transitions and the SMA/M1 for response-level transitions. However, the behavioral transition effects were also interactive, in that a violation of consecutive repetitions/switches at one level (task or response) removed the benefit of consecutive repetitions/switches at the other level, suggesting a common final pathway of controlled response selection. The fMRI data revealed this shared pathway to be located in the basal ganglia. In sum, we present novel evidence for two interactive medial frontal cortex-basal ganglia circuits that regulate the flexible implementation of task and response selection.

LANGUAGE: Syntax

A39

NEURAL CORRELATES OF UNACCUSATIVE AND UNERGATIVE VERB PROCESSING Julia Schuchard[1], Aneta Kielar[2], Elena Barbieri[3], Cynthia K. Thompson[1]; [1]Northwestern University, [2]Rotman Research Institute, [3]University of Milano-Bicocca — Unaccusative and unergative verbs both require a single argument but differ with respect to the argument structure entailed within their lexical entries. Unaccusatives select for a theme argument, which in sentences undergoes syntactic movement from the object to the subject position. Unergatives only select for an agent, which is base generated in the subject position; hence no object movement is required. The present study investigated the neural correlates of processing unaccusative and unergative verbs in sentence context using fMRI, with the hypothesis that the greater syntactic complexity of unaccusatives relative to unergatives would activate bilateral inferior frontal and posterior perisylvian regions. Stimuli included forty sentences with unergative verbs and forty with non-alternating unaccusative verbs. Half the sentences were semantically plausible and half implausible. Thirteen monolingual English speakers performed a semantic anomaly detection task while listening to blocks of sentences with unaccusative or unergative verbs. Participants also performed blocks of a pitch discrimination control task. Compared to pitch discrimination, processing of both sentence types elicited bilateral activation in anterior and posterior language regions, i.e., superior and middle temporal and inferior frontal gyri. As predicted, participants exhibited enhanced activations for sentences with unaccusatives relative to sentences with unergatives. Significant clusters of activation differentiating the two sentence/verb types were located in the right hemisphere. These results suggest that right hemisphere regions may be required for computing complex verb argument structure. The findings of the present study contribute to a growing body of work implicating right hemisphere regions in linguistic processes.

A40

THE PROCESSING OF MOVEMENT: AN EVENT-RELATED POTENTIALS INVESTIGATION OF PREPOSED ADJECTIVES Laura Bartlett[1], Kay-E. González-Vilbazo[1], Kara Morgan-Short[1]; [1]University of Illinois at Chicago — The P600 in linguistic event-related potentials (ERP) research has often been associated with reanalysis that occurs in response to grammatical errors or anomalous constructions (e.g. Osterhout & Holcomb, 1992). However, more recent work has found P600s in non-anomalous grammatical constructions that involve filler gap dependencies, such as those associated with wh-movement (e.g. Gouvea et al. 2010). The present project expands this research by examining processing in a different movement construction. We compare two types of adjectival modification: one involving prenominal Spanish adjectives that raise from their base position, the other involving prenominal adjectives that are base-generated as such. If movement resolution elicits a P600, we predict that the moved adjectives will show a P600 relative to the non-moved ones. In order to test this, we recorded EEG from native speakers of Mexican Spanish as they read determiner-adjective-noun phrases. ERPs were time-locked to the critical noun (where movement is resolved) and averaged across participants. Preliminary analysis shows no evidence of a P600 for either type of adjective; however, the moved adjectives show a localized, bilateral LAN in comparison to the non-moved type. We explore two possible interpretations for the data: 1) P600s are not elicited to movement, and the P600 seen in wh-movement is related to some other factor, such as thematic role integration at the point of movement

resolution; and 2) the adjectives we consider as moved do not actually move and this theory is in need of revision.

A41

BROCA'S AREA SHOWS A DISTANCE EFFECT FOR BOTH SYNTACTIC MOVEMENT AND BACKWARDS ANAPHORA IN FMRI William Matchin[1], Jon Sprouse[1], Gregory Hickok[1]; [1]University of California, Irvine — The processing of sentences sometimes requires the computation of long-distance dependencies, or relationships between non-adjacent elements of a sentence. One example is syntactic movement, whereby a moved element, the filler, must be linked with its original position in the sentence, the gap. Another example is referential binding, whereby a pronoun is linked with its antecedent. Santi & Grodzinsky, (2007) documented increased activation in the anterior portion of Broca's area in fMRI for sentences with a longer distance between filler and gap, but not for sentences with longer distance between antecedent and pronoun. The authors suggest that this region responds selectively to syntactic movement. However, the dependency resolution processes involved for syntactic movement are online and active (Stowe, 1986), given that the presence of a filler predicts a gap, whereas the dependency resolution processes for standard binding generates no such prediction (Kazanina, 2007). Therefore, the lack of a distance effect for the binding condition in Broca's area does not rule out the possibility that the activation for movement reflects other dependency resolution processes. The current study corrects for this by using backwards anaphora, wherein the pronoun precedes the antecedent, creating an online prediction for the antecedent. Our results show that backwards anaphoric sentences produce larger activation for sentences with a longer distance between pronoun and antecedent in the anterior portion of Broca's area, suggesting that the distance effects found for movement in this region do not reflect syntactic movement per se, but another dependency resolution process.

A42

ELECTROPHYSIOLOGICAL MEASURES REVEAL INDIVIDUAL DIFFERENCES IN BILINGUAL LANGUAGE PROCESSING Darren Tanner[1], Lee Osterhout[2]; [1]The Pennsylvania State University, [2]University of Washington — Research on native language (L1) processing using event-related potentials (ERPs) has shown that sentence-embedded semantic and morphosyntactic anomalies elicit qualitatively different brain responses (the N400 and P600, respectively). ERP studies of second-language (L2) processing have reported mixed results, with findings ranging from null results to similar processing profiles as L1. However, L2 learning and processing are particularly subject to significant individual variation, and grand-mean analyses typically used in ERP research obscure these differences. Here we show that individual differences in L2 ERP responses can be systematic, and that multivariate approaches to ERP measures can reveal important information about the nature of bilingual processing. Twenty high proficiency L1 Spanish-L2 English bilinguals read sentences containing morphosyntactic violations (e.g., "The key to the cabinet was/*were very rusty"). Grand-mean results showed both reliable N400 and P600 effects to the morphosyntactic anomalies. However, analyses of individuals' brain responses showed that most individuals showed either an N400 or P600, but not both, and that the magnitude of the two brain responses was negatively correlated within and across individuals. Multivariate analyses showed that over 60% of variance in individuals' relative response dominance (N400 or P600) was predicted by five factors: age of L2 acquisition, length of immersion, L2 proficiency, frequency of L2 use, and motivation to learn English. Overall, our results show that spurious theoretical interpretations can result when ERPs are averaged over individuals showing qualitatively different responses, but that simple analytical techniques can be applied to ERP data to reveal factors related to individual processing profiles.

A43

WHEN THE SPEAKER IS PRESENT: PROCESSING DIFFERENT PERSON SPECIFICATIONS IN BASQUE SUBJECT-VERB AGREEMENT Simona Mancini[1], Nicola Molinaro[1], Jon A. Duñabeitia[1], Stephanie Massol[1], Manuel Carreiras[1,2]; [1]BCBL, Basque Center on Cognition Brain and Language, [2]Ikerbasque, Basque Foundation for Science — The electrophysiological correlates of agreement processing are normally identified in P600 effects, often preceded by negative effects. In this ERP study we explore agreement comprehension and its interaction with discourse focusing on the alleged asymmetry between 1st and 3rd person plural forms, according to which the composite makeup of the former, a group including a participant (speaker) and non-participants (e.g. we=I+they), contrasts with the homogeneous non-participant composition of the latter (they=he+he). To investigate the sensitivity of comprehension mechanisms to this asymmetry, we used a distinctive phenomenon of Basque: the proximity plural suffix –ok. Unlike the fixed 3rd person plural interpretation of –ek suffixes (japonarri-ek, the Japanese), -ok shifts the interpretation to 1st person plural (japonarri-ok, we japanese). In an ERP experiment (N=20), person violations were created with –ok and -ek manipulating the inclusion/exclusion of the speaker in verbal inflection: (1) Ikastaroan japoniarr-ek3.pl euskara ikasi dute3.pl gustora; (2) Ikastaroan japoniarr-ek3.pl euskara ikasi *dugu1.pl gustora; (3) Ikastaroan japoniarr-ok1.pl euskara ikasi dugu1.pl gustora; (4) Ikastaroan japoniarr-ok1.pl euskara ikasi *dute3.pl gustora (In class, the/we Japanese learned Basque with pleasure). Both violations elicited an N400 effect, suggesting discourse involvement in person processing, but only –ok violations generated a P600, arguably reflecting integration operations to accommodate the non-participant representation invoked by the verb with the speaker-related one underlying the subject. Results show that the presence of an agreement violation does not necessarily correlate with P600 effects, whose emergence appears to be sensitive to fine-grained discourse information such as the type and role of speech participants involved.

A44

MORPHO-SYNTACTIC PROCESSING IN LATE BILINGUALS: COMBINED EVIDENCE FROM ERPS AND FMRI Eleonora Rossi[1], Judith Kroll[1], Paola Dussias[1]; [1]Pennsylvania State University — The successful processing of morpho-syntactic parameters in adult second language (L2) learners can be influenced by several factors, including age of acquisition and proficiency. Still under debate is how grammatical similarity between the native (L1) and the L2 impacts the neurophysiological bases and the amount of cortical activation in the L2. Recent neuroimaging studies report that native-like processing is possible only when the two languages share similar grammatical structures, while others suggest that L2 learners are sensitive to structures that are unique to the L2 (Jeong et al., 2007; Sabourin & Stowe, 2008). In two experiments we address this issue, attempting to combine high-temporal and high-spatial resolution data utilizing Event Related Potentials (ERPs) and functional Magnetic Resonance Imaging (fMRI). In Experiment 1, we recorded ERPs in native Spanish (n=16) and high-proficient English-Spanish bilinguals (n=15), utilizing clitic pronouns which differ between English and Spanish (in Spanish: marked for gender and number). Results reveal that native speakers showed a larger positivity in the 500-700 ms window for violations of gender and number, while L2 speakers show a larger positivity for number violations. In Experiment 2 (in progress) we utilize the same grammatical structure utilizing fMRI to measure cortical activation in a similar population, with the goal of testing a subset of the participants from Experiment 1. We hypothesize that if L2 speakers are not sensitive to grammatical gender (as observed in Experiment 1) the location and/or the amount of cortical activation should likewise also differ between native and L2 speakers.

A45

DOUBLY QUANTIFIED SENTENCES: SHALLOW VS. DEEP PROCESSING Veena Dwivedi[1], Raechelle Gibson[1], Leanne Angus[2]; [1]Brock University, [2]University at Buffalo — Language comprehension requires integration of information derived from world-experience and grammar. Nevertheless, how these different sources of information interact is debated. The present work suggests that language processing requires both heuristic (shallow) and algorithmic (deep) processing streams, where the heuristic processing strategy precedes the algorithmic phase. This claim contrasts with recent accounts in the ERP language literature, which propose that these two streams operate in parallel. However, I suggest that evidence supporting the parallel processing model could be artefacts of Event Related Potential (ERP) language methodology. The proposal is based on three self-paced reading experiments in which the processing of two-sentence discourses was investigated, where context sentences exhibited quantifier scope ambiguity. Experiment 1 demonstrates that such sentences are processed in a shallow manner. Experiment 2 uses the same stimuli as Experiment 1 but adds questions to ensure deeper processing. Results indicate that reading times are consistent with the lexical-pragmatic interpretation of number associated with context sentences, whereas responses to questions are consistent with the algorithmic computation of scope. Experiment 3 shows the same pattern of results using stimuli exhibiting a different lexical-pragmatic bias. These results suggest that for certain constructions, language processing is superficial and deeper processing sensitive to structure only occurs if required. Implications for recent studies of scope ambiguity are discussed.

LONG-TERM MEMORY: Priming

A46

CONSCIOUS INTENTIONS MODULATE THE WAY SUBLIMINAL WORDS ARE PROCESSED Simone B. Duss[1,2], Thomas P. Reber[1,2], Katharina Henke[1,2]; [1]Division of Experimental Psychology and Neuropsychology, Department of Psychology, University of Bern, Switzerland, [2]Center for Cognition, Learning, and Memory, University of Bern, Switzerland — Prime stimuli that are presented too briefly to be consciously perceived can nevertheless affect responses to subsequent target stimuli. Such effects are evidence of unconscious cognition. Here, we investigated whether the meaning of subliminal words is processed automatically, or whether the focus of ongoing conscious cognition affects the way we process subliminal words. We manipulated the participants' focus of conscious cognition by using two different task instructions. Half of participants judged the target words' meaning according to pleasantness (yes, no) and the other half according to comprehensibility to a child (yes, no). Prime-target pairs were either semantically related (desk-table) or not (desk-car). Following the main experiment, all participants also judged the prime words (that were invisible) according to this (focused) instruction. Then, participants viewed all words (primes and targets) again to evaluate them according to the instruction given to the other half of participants in the main experiment (non-focused instruction). This procedure allowed to sort trials into congruently and incongruently evaluated prime-target pairs according to the focused and non-focused instruction. An effect of congruency manifested only for the focused but not for the non-focused instruction. This effect emerged if primes and targets were semantically related. This is evidence that subliminal words underwent genuine semantic analyses, and that these analyses were affected by the focus of ongoing conscious cognition. Hence, even unconscious processing of information can be intention-driven, which restricts the possibility of automatic, unintended manipulation by subliminal stimuli.

A47

EARLY PROCESSING DIFFERENCES FOR RAPID RESPONSE LEARNING FOR FACES Christian Valt[1], Werner Sommer[2], Christoph Klein[1], Stephan G. Boehm[1]; [1]Bangor University, [2]Humboldt University at Berlin — Information processing, for example recognizing a face, becomes faster and more accurate when the same information has been processed before. This facilitation can result from rapid response learning, a binding of stimuli to particular categorizations or responses made. Rapid response learning is revealed as reduced facilitation when the categorization/response between study and test phases is reversed in comparison to keeping the categorization/response identical. The neural underpinnings of rapid response learning are not fully clear yet. Here, we used event-related brain potentials (ERPs) to investigate the time course of processing associated rapid response learning. Participants performed nationality judgements on faces of German and American celebrities. Two study phases were followed by a single test phase, in which both faces from the study phases and faces not shown before were presented. The categorization in one of study phases was identical to the categorization in the test phase and reversed in the other study phase. Response times were faster when faces were tested with the identical categorization in comparison to reversing the categorization, indicating rapid response learning. ERP to repeated faces were more positive than ERPs to new faces at middle centro-parietal electrodes around 450-750ms and more negative at left frontal electrodes around 550-1000ms. These ERP repetition effects were similar for identical and reversed categorizations. Rapid response learning was associated with an early fronto-central negativity around 300-350ms. These results suggest that rapid response learning results from processes that are dissociable and occur earlier than other memory processes resulting from stimulus repetition.

A48

THE ROLE OF PERCEPTUAL AND CONCEPTUAL PRIMING IN OBJECT IDENTIFICATION IN ALZHEIMER'S DISEASE. Erin P. Hussey[1], Philip C. Ko[1], Bryant Duda[1], Nicholas R. Simmons-Stern[2], Rebecca G. Deason[2], Brandon A. Ally[1]; [1]Vanderbilt University, [2]VA Boston Healthcare System — Object identification can be problematic for patients with Alzheimer's disease (AD). However, it is unclear as to whether this problem is based in degraded perceptual processing or disrupted semantic networks. Recent work suggests a common neural representation supports object identification and implicit memory, making priming an excellent candidate to understand the type of information that mediates object identification in patients. Implicit memory research shows intact perceptual priming in AD, while conceptual priming results are discrepant. To understand whether perceptual and conceptual priming can facilitate object identification in AD patients, patients and healthy controls completed an incidental learning size judgment task using line drawings of common objects. Participants later performed a picture fragment completion test in which 10% of the visual object was revealed every 500 ms. Participants made a button press as soon as they could identify the object. Test pictures were studied, unstudied, or unstudied exemplars drawn from the same basic-level categories as the studied objects. Thus far, both AD patients and controls show faster reaction times for the studied items compared to the exemplar and unstudied items, indicating a benefit of perceptual priming on object identification. However, only controls showed faster reaction times for exemplar items compared to unstudied items, indicating a benefit of conceptual priming. These preliminary results suggest that AD patients can utilize perceptual information available from implicit memory to facilitate object identification. However, likely due to disrupted semantic networks, patients are unable to utilize conceptual information to support object identification.

A49

NEURAL CORRELATES OF ITEM AND CATEGORY-LEVEL PRIMING IN OBJECT IDENTIFICATION Brandon Ally[1], Philip Ko[1], Bryant Duda[1], Erin Hussey[1], Emily Mason[1]; [1]Vanderbilt University — Implicit memory can facilitate subsequent object identification. But at what level of representation does implicit memory benefit object identification? Implicit memory can benefit the item-specific or the category-wide features of an object during identification. To examine this question, young adult participants completed an incidental learning size judgment task using line drawings of common objects. Participants later completed a picture fragment completion test in which 10% of the visual object was revealed every 500 ms. Participants made a button press as soon as they could identify the

object. The test pictures were studied, unstudied, or unstudied exemplars drawn from the same basic-level categories as the studied objects. Behavioral results showed faster reaction times for the studied items compared to the exemplar and unstudied items, indicating item-specific priming. Additionally, responses to exemplar items were faster than those to unstudied items, indicating category-wide priming. Event-related potentials (ERP) recorded during the identification task showed repetition suppression effects related to the behavioral priming. Importantly, scalp topographies showed distinct repetition suppression effects. Central posterior regions showed repetition suppression activity for both studied and exemplar items relative to unstudied items, indicating category-wide priming. In contrast, right posterior regions showed repetition suppression activity for studied items compared to exemplar and unstudied items, indicating item-specific priming. Moreover, these effects were temporally similar, suggesting that category-wide priming and item-specific priming likely occur in parallel. These results are consistent with previous theories proposing that parallel systems in distinct neural regions mediate the identification of an item and its category.

A50

IMAGING CROSS-MODAL REPETITION SUPPRESSION EFFECTS IN THE HUMAN TEMPORAL LOBE Andrew Heusser[1], Tari Awipi[1], Lila Davachi[1]; [1]New York University — Representing information in a conceptual and flexible way is fundamental to our ability to understand and manipulate information about our environment. However, it is unclear how we obtain and store these conceptual representations. One prominent view is that while multiple brain areas may be involved in the encoding of information from different sensory modalities, specific brain regions in the temporal cortex involved in cross-modal integration might serve as a conceptual hub (Patterson et al., 2007). To identify putative regions supporting conceptual representations, we employed a cross-modal repetition suppression (RS) paradigm. On each trial, subjects were presented with one of three different modality stimuli: visual words, auditory words or visual pictures. On each trial, subjects made a size judgment. Each 'concept' was repeated (within 1 – 4 trials) either within-modality (for e.g. a visual word followed by a visual word repeat) or across-modality (e.g. an auditory word followed by a visual word repeat). Behavioral analyses revealed both within and across modality priming effects, where response times for repeated trials were significantly faster in all within-modal and cross-modal conditions. As expected, fMRI analyses suggested modality specific RS effects in cortical sensory areas. Furthermore, preliminary conjunction analyses reveal modality independent RS effects in anterior and posterior regions of temporal cortex. Further analyses will be performed to explore brain regions whose neural suppression effects correlate with behavioral priming effects. These results suggest that regions in the temporal lobe may serve as a conceptual hub, representing information irrespective of modality.

NEUROANATOMY

A51

EFFECTS OF AGE AND PHYSICAL FITNESS ON BRAIN ANATOMY AND NEUROPSYCHOLOGICAL TEST SCORES IN HEALTHY AGING ADULTS Mark Fletcher[1], Kathy Low[1], Nils Schneider-Garces[1], Timothy Weng[1], Rachel Boyd[1], Anthony Majewski[1], Benjamin Zimmerman[1], Chin Hong Tan[1], Brian Gordon[2], Gabriele Gratton[1], Monica Fabiani[1]; [1]University of Illinois at Urbana-Champaign, [2]Washington University in St. Louis — Healthy aging adults experience differing degrees of anatomical and neuropsychological changes. Evidence indicates that some of these effects may be mediated by Cardio-Respiratory Fitness (CRF). To investigate the relationships between these factors, structural Magnetic Resonance Imaging (sMRI) was recorded in a group of healthy older adults (N=55, age range 55-87), who were also administered a battery of neuropsychological tests. Anatomical volumes of interest, normalized for Intracranial Volume (ICV), were obtained through automated reconstruction by FreeSurfer©. CRF estimates were obtained using a regression model proposed by Jurca and colleagues (2005). A multivariate analysis was performed to investigate the effects of age, CRF, and education on brain anatomy and neuropsychological performance. Our analysis demonstrated significant correlations between increasing age and volumetric decline in total gray/white matter, specific regions including the hippocampus and parts of the inferior frontal gyrus, as well as with a number of neuropsychological variables. Importantly, after the effects of age were partialed out, CRF was associated with total hippocampal and entorhinal cortex volumes, and with scores on the Modified Mini-mental Status examination. Our data are consistent with the proposal that CRF might be a mediating factor in the cognitive advantages and anatomical preservation experienced by higher-fit, compared to lower-fit older adults.

A52

NEUROMORPHONAUT: NEUROANATOMY FOR FMRI Andrew Worth[1], Gregory Millington[1], Jason Tourville[2]; [1]Neuromorphometrics, Inc., [2]Boston University — Accurate anatomical localization is essential in fMRI. Human brain atlases are evolving from a 2D, physical, single-brain set of pictures and drawings (a book), through a CDROM of pdf files, into software that: has stereotaxic coordinates, contains multiple brains, explicitly represents regions, is searchable and has interactive processing and visualization capabilities. "NeuroMorphoNaut" (NMN) is a platform for neuroanatomical analysis that is based on a database of a large number of manually labeled MRI brain scans. We present initial results from an ongoing project to comprehensively label on the order of 1000 scans. In the context of the user's individual scan, NMN provides neuroanatomical information using a probabilistic atlas that was created from the manually labeled scans. The user can view and interact with this information along with information from traditional atlases. Scans were labeled using a protocol that precisely defines the landmarks, borders and methods for delineating more than 150 regions covering the entire brain. So far, 40 structural scans have been labeled (20 subjects scanned at two different times). The probabilistic atlas was created from these scans and is used to understand the anatomy of an individual scan by warping the atlas into the native space of that scan. The atlas displays a list of ROIs in order of their probability for any point in the scan. NeuroMorphoNaut is a dynamic interactive probabilistic brain atlas that will enable a deep understanding of normal structure and its variation and will help address the localization problem in functional neuroimaging.

A53

THE EFFECTS OF HIPPOCAMPAL LESIONS ON RETRIEVAL ORIENTATION UNDER SHORT- AND LONG-DELAY CONDITIONS Alex Konkel[1], David E. Warren[2], Melissa Duff[2], Daniel Tranel[2], Neal J. Cohen[3]; [1]Washington University in St. Louis, [2]University of Iowa Carver College of Medicine, [3]University of Illinois Urbana-Champaign — There has been considerable interest in recent years in the idea that the functional role of the hippocampus may be more extensive that previously held. The current experiment addressed this issue, examining the hippocampus' possible involvement in novelty processing and on the timescale not only of long-term but also working memory. We tested patients with hippocampal amnesia on delayed-match-to-sample and delayed-non-match-to-sample tasks, thus manipulating novelty processing via retrieval orientation, under both short- and long-delay conditions. Both behavioral and eye movement measures were collected. Amnesic patients performed similarly to intact comparison participants after a short delay but were impaired after a long delay, with no effect of hippocampal damage on retrieval orientation, i.e., amnesia affected both tasks equally. The eye movement data revealed familiarity effects for all participants, and suggested that participants used familiar items to guide their task performance even under novelty conditions. Taken together, there is no evidence in these results of impairment in novelty processing following damage to the hippocampus, and thus of any special role of the hippocampus in novelty processing beyond what would derive from its contribution to declarative or relational memory.

A54

PREFRONTAL CORTEX DEVELOPMENT IN POST-INSTITUTIONALIZED ADOLESCENTS Amanda Hodel[1], Ruskin Hunt[1], Megan Gunnar[1], Kathleen Thomas[1]; [1]University of Minnesota — For children reared internationally in institutions, multiple aspects of the early environment deviate from biological expectations, leading to potential alterations in brain development. Given that the prefrontal cortex shows protracted development across adolescence, the purpose of this project was to investigate prefrontal cortex development in 12-14 year old children who were internationally adopted from institutions before 72 months of age. To date, eighty-two post-institutionalized children (PI group) and a comparison group of 38 children raised with their biological families (control group) have participated. Children completed a T1-weighted high-resolution anatomical scan on a Siemens 3T Trio scanner. Cortical reconstruction and volumetric segmentation was performed with the Freesurfer image analysis suite. Statistical analyses of volume and cortical thickness included age, gender, and a measure of total intracranial volume or average cortical thickness as covariates. Results indicated that control children had significantly larger bilateral prefrontal volumes than PI children, driven by volumetric reductions in PI children in left lateral orbitofrontal cortex and in bilateral portions of the superior and inferior frontal gyri. Group differences in cortical thickness were detected in bilateral caudal anterior cingulate, left medial orbitofrontal cortex, and left frontal pole, where control children had thinner cortices than PI youth, potentially representing developmental differences in pruning. These data suggest there are persisting effects of early deprivation on prefrontal cortex development in PI children. As part of a larger study, this project will investigate if alterations in prefrontal cortex morphology underlie difficulties experienced by many PI children in cognitive and socioemotional domains.

A55

AMYGDALA MORPHOLOGIC DIFFERENCES IN WILLIAMS SYNDROME Kristen E. Sheau[1], Brian W. Haas[1], Ryan G. Kelley[1], Paul Thompson[2], Allan L. Reiss[1]; [1]Stanford University, [2]UCLA — Williams syndrome is a genetic disorder often characterized by increased socially appetitive behavior, increased non-social anxieties, and developmental delays. Some of these unique behavioral traits may be explained by volumetric and morphologic differences in the amygdala, a structure involved in processing social and emotional stimuli. In this study, 44 individuals with Williams syndrome and a control group of 41 typically developing individuals underwent structural Magnetic Resonance Imaging on a GE 3 Tesla magnet. Total brain volumes were calculated and amygdalae were automatically delineated using FreeSurfer. Individual images were normalized to standard space. Spatial locations of amygdala structural differences between the two groups were determined using a mesh-based surface modeling approach. The Williams syndrome group showed multiple regions in both the left and right amygdalae that were significantly enlarged as compared to the control group. The finding of localized structural abnormalities of the amygdala contributes to a model linking genetic risk in Williams syndrome to alterations in brain regions important for social and emotional processing.

A56

DOMINANT FREQUENCIES OF HUMAN CORTICAL OSCILLATORY ACTIVITY IN A RESTING STATE AS MEASURED BY THE ELECTROCORTICOGRAM David Groppe[1], Stephan Bickel[2], Corey Keller[2], Lazlo Entz[3], Ashesh Mehta[1]; [1]Feinstein Inst. for Medical Research, Long Island, NY, [2]Albert Einstein College of Medicine, New York, NY, [3]National Institute of Neuroscience, Budapest, Hungary — Human cortical electrical potentials often exhibit clear oscillatory activity at characteristic frequencies (e.g., alpha activity from 8-12 Hz). The strength of these oscillations has been found to vary between cortical areas, which presumably reflects differences in the dynamics of the functional networks to which these areas belong. However, characterizing these frequencies for different cortical areas has generally been difficult due to the poor spatial or temporal resolution of non-invasive measures of cortical activity (e.g., EEG). Here we remedy this problem by using an invasive measure of cortical potentials, the electrocorticogram (ECoG), with high temporal and relatively good spatial resolution. Specifically, we measured the spectral power of two separate periods of several minute long ECoG recordings in 11 subjects while they rested or watched television. Cortical areas under each electrode were estimated using individual subject MRIs/CT scans and the FreeSurfer Desikan-Killiany Atlas, which parses cortex into 35 areas. Mean spectral power per cortical area generally exhibited strong theta (5-7 Hz) or alpha activity. Areas with pronounced alpha activity were primarily in the lateral parietal and occipital lobes, though several additional areas (e.g., lingual and fusiform gyri) also showed alpha peaks. Areas with strong theta peaks tended to lie on the medial surface (e.g., posterior cingulate, medial orbitofrontal, and parahippocampal). Moreover, comparison of spectra across the two recording sessions found these tendencies to be generally reliable. These results indicate that alpha oscillations are not as predominant throughout cortex as has been suggested previously and should help the interpretation of resting/background scalp EEG/MEG.

A57

STRUCTURAL CORRELATES OF WORKING MEMORY AND EPISODIC RECALL WITH AN AUTOMATED SEGMENTATION ALGORITHM Michael A. Sugarman[1], John L. Woodard[1]; [1]Wayne State University — Objective: Alzheimer's disease is characterized by cortical and hippocampal atrophy, in addition to episodic and working memory impairment. Hippocampal atrophy correlates with memory performance in older adults with or without dementia. We investigated the relationship between volumetric measurements of several brain regions and indices of verbal working memory and delayed episodic memory performance. Methods: Study participants included probable Alzheimer's patients (n=16, Age=69.4 years) and age, gender, and education matched cognitively intact controls (n=17, Age=70.4 years). All participants completed three 5- and 10-word working memory word rehearsal tasks, followed by a delayed free recall of the word lists. Structural magnetic resonance imaging scans for each participant were analyzed using Functional MRI of the Brain's Integrated Registration and Segmentation Tool (FIRST), producing volumetric measures of total white and gray matter (corrected for total intracranial volume), hippocampus, caudate, thalamus, putamen, amygdala, accumbens, pallidum, and brainstem. Results: For all participants, total gray matter, combined white and gray matter, hippocampus, and brainstem volume were all significantly correlated with the number of unique words verbally rehearsed during the working memory task and delayed episodic recall performance. Caudate volume was only correlated with episodic memory ($r>.38$ and $<.60$ for all significant correlations). Discussion: These results suggest that volumetric measures of global atrophy and atrophy of the hippocampus, brainstem, and caudate may be valid measures of memory functioning and impairment in older adults. The observed effects are detectable with an automated segmentation procedure and do not require time-intensive manual tracing, which is an advantage of this tool.

A58

THE SPACE STUDY: SPATIAL NAVIGATION TRAINING TRIGGERS BEHAVIORAL AND NEURAL CHANGES Elisabeth Wenger[1], Sabine Schaefer[1], Nils Bodammer[1], Hannes Noack[1], Simone Kühn[2], Johan Mårtensson[3], Hans-Jochen Heinze[4,5], Emrah Düzel[4,5,6], Lars Bäckman[7], Ulman Lindenberger[1], Martin Lövdén[1,3,7]; [1]Max Planck Institute for Human Development, Berlin, [2]Ghent University, [3]Lund University, [4]Otto-von-Guericke University of Magdeburg, [5]German Centre for Neurogenerative Disorders, [6]University College London, [7]Karolinska Institute — It is unknown whether an active lifestyle and appropriate training interventions may improve spatial navigation performance and affect its underlying neural substrates. Here, we investigate whether spatial ability can be improved by a cognitively demanding spatial navigation training, whether this training evokes changes in cortical and subcortical brain structures, and whether these effects are differential for age groups. Ninety-one men

aged 20-30 or 60-70 years participated in the 4 months navigation training, with 50-min-training sessions every other day. Younger as well as older navigators evidence large improvements in navigation performance that are partly maintained 4 months after termination of training. The navigation groups display stable hippocampal volumes whereas control groups show hippocampal volume decrements consistent with longitudinal estimates of age-related decline. We also find that in the young age group, changes in demands on spatial navigation induce increases of N-Acetylsspartate (NAA) in the right hippocampus of brain-derived neurotrophic factor (BDNF) Val homozygotes but not of Met carriers. We do not detect this association in older adults. Additionally, we report training-related cortical thickening in left precuneus and paracentral lobule that is observed in young navigators only. Thus, spatial navigation training appears to affect cortical as well as subcortical brain structure in a differential way for young and old adults.

OTHER

A59

CHOOSING THE RIGHT SEAT: REAL WORLD SEATING BIASES EXAMINED Victoria Harms[1], Miriam Reese[1], Lorin Elias[1]; [1]University of Saskatchewan — Lateral biases can be seen throughout the range of human behavior. Research examining lateral biases in seating preference has shown that participants tend to choose seats on the right side of movie theatres more than seats on the left side (Karev, 2000; Okubo, 2010). However, these studies have relied on participants choosing a location based on a seating chart rather than examining real-world behavior. Adding a new dimension to the solely chart-based seating choice literature, the current study investigated whether right-side seating biases were present in the natural setting of an actual movie theatre. Digital photographs taken from the projection booth of a mid-sized independent movie theatre were used to assess seating biases. These images revealed a significant bias for movie-goers to select seats to the right of center. Consistent with prior research these results support the view that people will preferentially position themselves to most efficiently process information. Movies provide primarily visual and emotional content, both of which are preferentially processed within the right hemisphere. It is thought that people position themselves on the right side of the theatre so that the screen falls mainly within the left side of visual space. As information from the left hemifield is sent directly to the right hemisphere to be processed, right-side seating maximizes the efficiency of visual and emotional processing.

A60

LEARNING FROM POSITIVE AND NEGATIVE FEEDBACK IN PARKINSONISM: DISSOCIATION BETWEEN ACTIVE AND OBSERVATIONAL LEARNING Stefan Kobza[1], Martin Suedmeyer[2], Bettina Pollok[2], Stefano Ferrea[2], Alfons Schnitzler[2], Christian Bellebaum[1]; [1]Ruhr University Bochum, [2]Heinrich-Heine University Duesseldorf — Feedback to both actively performed and observed behavior allows adaptation of future actions. For active learning, positive feedback leads to increased activity of dopamine (DA) neurons in the substantia nigra, whereas DA neuron activity is decreased following negative feedback. DA level reduction in unmedicated Parkinson's Disease (PD) patients has been shown to lead to a negative learning bias, i.e. enhanced active learning from negative feedback. Recent findings suggest that the neural mechanisms of active and observational learning from feedback might differ, with the DA system playing a less prominent role in observational learning. Therefore, we hypothesized that unmedicated PD patients would show a negative learning bias in active but not in observational learning. In a between-group design, PD patients and healthy controls performed either an active or an observational probabilistic feedback-learning task. At the end of both tasks, a transfer phase aimed to assess the bias to learn better from positive or negative feedback. As expected, actively learning patients showed a negative learning bias, which was, however, caused by reduced positive learning relative to controls. In contrast, patients who learned by observation learned equally well from positive and negative feedback, which was comparable to controls. These findings add to neural models of reinforcement-learning by suggesting that observational feedback learning – compared to active feedback learning – relies less on the DA system. Future research may investigate the role of other structures such as the medial temporal lobe in observational feedback learning.

A61

THE NEURAL CORRELATES OF MAPPING NUMERICAL AND NON-NUMERICAL QUANTITIES INTO SPACE Stephan Vogel[1], Roland Grabner[2], Michael Schneider[3], Robert Siegler[4], Daniel Ansari[1]; [1]University of Western Ontario, Canada, [2]ETH-Zurich, Switzerland, [3]University of Trier, Germany, [4]Carnegie Mellon University, United States — Research into the neural correlates of numerical cognition has implicated the intraparietal sulcus (IPS) as a key region for processing numerical magnitudes. Moreover, a growing body of evidence suggests a tight link between representations of space and number. Space is frequently used as a reference frame - the number line being a prominent example – and it has been demonstrated that use of spatial representations in education helps to improve the understanding of numerical magnitudes. However, how the human brain mediates the mapping of numbers into space is not well understood. The present study seeks to answer this question by measuring brain activity, while participants performed a numerical estimation (NE) and a brightness estimation (BE) task in a 3 Tesla functional Magnetic Resonance Imaging scanner. In the NE condition, participants were asked to estimate the correct position of a given target number on a presented number line ranging from 0 – 100. In the BE condition, participants were asked to estimate the correct position of a given gray level on a continuous line that ranged from white (i.e., 0) to black (i.e., 100). Analysis demonstrated number specific activations in bilateral regions of the anterior IPS, and common activation (NE and BE) in right parietal areas, spanning the IPS and posterior superior parietal lobes. Results of this study suggest that the parietal lobe plays a critical role in mapping numerical and non-numerical magnitudes into space. Moreover, this study identified regions that are specifically involved in the mapping of numbers into space.

A62

THE CINGULUM BUNDLE IN PEOPLE WITH TYPE 2 DIABETES: A DIFFUSION TENSOR IMAGING STUDY Wouter S. Hoogenboom[1,2], Veronica L. Flores[1], Nicolas R. Bolo[3], Donald C. Simonson[2], Alan M. Jacobson[1,3,4], Jason S. Schneiderman[2], Marek Kubicki[2], Martha E. Shenton[2], Gail F. Musen[1]; [1]Joslin Diabetes Center, [2]Brigham & Women's Hospital, [3]Beth Israel Deaconess Medical Center, [4]Winthrop-University Hospital — The cingulum bundle (CB) is a major white matter tract that connects the frontal and parietal lobes with parahippocampal and adjacent temporal regions, and is involved in memory, executive function, and emotion. It also plays a role in interconnecting the active regions of the default mode network, which may be affected in Type 2 diabetes mellitus (T2DM). Using diffusion tensor imaging (DTI), we measured diffusion within the CB in thirteen people with T2DM and seventeen control non-T2DM subjects who were matched for age, gender, education, and Body Mass Index. IQ was higher in the control group (114±12) than in the T2DM group (104±14, p=0.04), thus we controlled for IQ in our analyses. We collected 3T DTI images and neuropsychological data on all subjects. After regions-of-interest (ROI) were placed on a color-by-orientation map for each individual, we calculated DTI-derived diffusion values from the resulting ROI seed-based tractography to assess overall white matter health (fractional anisotropy, FA; trace), as well as measures related to axonal integrity (axial diffusion) and axonal myelination (radial diffusion). After IQ-correction, people with T2DM had lower FA and axial diffusion in the right CB compared to controls. Also, better performance on delayed-recall and letter-fluency was correlated with higher axial diffusion in controls, but not in people with T2DM. These results suggest that axial diffusion may be altered in the CB of T2DM patients despite

normal cognitive performance, and the underlying white matter pathology may be related to abnormalities in axon integrity.

A63

PROTECTIVE EFFECT OF ROFECOXIB AND CAFFEIC ACID AGAINST INTRAHIPPOCAMPAL KAINIC ACID-INDUCED MEMORY DYSFUNCTION IN RATS Atish Prakash[1,2], Deeksha Pahwa[1], Anil Kumar[1]; [1]Pharmacology Division, University Institute of Pharmaceutical Sciences, Panjab University, Chandigarh-160014, INDIA, [2]Pharmacology Division, Institute of Pharmacy and Emerging Sciences, Baddi University, Baddi, HP, INDIA — Role of neuroinflammatory mediators particularly cyclooxygenase, lipoxygenase, have been well suggested in the pathophysiology of neurodegenerative disorders. Rofecoxib is a selective cyclooxygenase 2 enzymes belongs to non-steroidal anti-inflammatory drug, commonly called as coxibs. Whereas, caffeic acid is one of the natural phenolic compounds and reported to inhibit 5-lipoxygenase activity as one of mechanisms. Present study has been designed to investigate the effects of rofecoxib, caffeic acid against intrahippocampal kainic acid-induced cognitive impairment, oxidative damage and mitochondrial respiratory enzyme alterations in rats. Kainic acid was administrated in the hippocampus region of rat brain. Various behavioral (locomotor activity and memory performances were assessed by using actophotometer and Morris water maze respectively) followed by oxidative stress, mitochondrial enzyme complex were assessed. Intrahippocampal administration of KA significantly impaired locomotor activity, memory performance, mitochondrial enzyme complexes and caused oxidative stress as compared to sham treatment. Rofecoxib (5 and 10 mg/kg), caffeic acid (5 and 10 mg/kg), treatment for 14 days significantly improved locomotor activity, memory retention and oxidative defense in hippocampus. Besides, alterations in the levels of mitochondrial enzymes and acetylcholine esterase enzyme were significantly restored by rofecoxib and caffeic acid as compared to control. Further, combination of rofecoxib (5 mg/kg) with caffeic acid (5 mg/kg) treatments significantly potentiated their protective effect which was significant as compared to their effect per se. The results of the present study suggest that the protective effect of rofecoxib and caffeic acid against kainic acid induced cognitive impairment and associated oxidative damage

PERCEPTION & ACTION: Other

A64

ELECTROPHYSIOLOGICAL EVIDENCE FOR SCALAR VARIANCE IN TEMPORAL PROCESSING Jamie N. Hershaw[1], Paul D. Kieffaber[1]; [1]The College of William and Mary — Overt timing behaviors frequently exhibit properties of scalar variance, wherein the variance of reproduced temporal intervals increases linearly as a function of interval duration. Scalar expectancy theory (SET) attributes this property of scalar variance to the internal clock, memory, and decision-making components of SET. Previous research has encountered difficulty isolating sources of variance and evidence for scalar variance in the neural correlates of temporal processing is sparse. The goal of the current research was to determine whether omission-evoked potentials (OEP) would exhibit scalar variance consistent with SET. Participants performed a finger tapping task in which they tapped in sync with tones separated by 350, 450, 550, or 650ms intervals, and continued tapping with the same intervals when the tones were omitted. This paradigm enabled us to isolate the memory component of SET. Results demonstrated that the width of the latency increased as the inter-tone interval increased. Furthermore, the onset latency, but not the offset latency, of OEPs exhibited scalar variance. This is interpreted as evidence for scalar variance in the memory component of SET.

A65

DISSOCIABLE REPRESENTATIONS OF ACTION MEANS AND OUTCOMES: EVIDENCE FROM STROKE Solene Kalenine[1], Laurel J. Buxbaum[1], Allison D. Shapiro[1]; [1]Moss Rehabilitation Research Institute, Philadelphia — Previous neuroimaging research in healthy adults has shown that during action observation, coding action means (i.e. how the action is performed) recruits posterior regions, particularly in the left hemisphere, while coding action outcomes (i.e. consequences of the action) activates more anterior regions, particularly in the right hemisphere (Hamilton and Grafton, 2008). Following these findings, we assessed the prediction that these two components of action representation would dissociate in stroke patients. Participants watched pairs of short videos of object-related actions and decided whether the two actions were the same or not. Whereas the objects in the videos were kept constant (e.g. sponge), the two actions displayed could differ according to their means (e.g. different wipes to remove detergent), outcomes (e.g., same wipe to remove or apply detergent), or both (different wipes to remove or apply detergent). Errors and response times were measured. Results from 21 left hemisphere stroke patients indicate that damage to left IPL correlates with relatively greater impairment in action means coding. This selective deficit was not associated with overall lesion volume or cognitive impairment severity. Analysis at the voxel level in this region of interest confirmed that patients with IPL lesion perform more poorly on means coding than patients without IPL lesions. In contrast, neither damage to left anterior areas nor right hemisphere lesions (10 patients) were related to means or outcome coding deficits. These findings demonstrate that action means and outcome coding can dissociate after stroke, with left IPL selectively supporting representation of action means.

A66

THE INFLUENCE OF NEURAL CODING ON NUMERICAL COGNITION Richard Prather[1]; [1]Indiana University — Though research has begun to describe neural coding of number, it is unclear how specific characteristics of the neural coding may relate to the expansive list of behavioral phenomena in number cognition. In the current study I present a series of simulations that demonstrate how the neural coding of number magnitude may contribute to several behavioral phenomenon described in the cognitive literature. I also demonstrate that the model predicts counterintuitive limitations on numerical cognition that may be evaluated with behavioral methods. The simulations reported are based on multiple nonhuman primate neural studies and computational accounts that have reported both proportional scaling and positive linear skew in the neural tuning functions for number magnitudes (e.g., Nieder & Dehaene, 2009). Given these characteristics of the neural coding, and the use of parameters to account for some neurocognitive development (e.g. noise, tuning function sharpening) a simple model of neural activity shows that patterns errors in the neural coding mirror the specific error patterns observed in human participants. The results suggest that several behavioral phenomena are to some degree, a "natural result" of the neural coding. Cognitive accounts of the number cognitive phenomena are not necessarily inconsistent with the current account. However, the current account requires a priori only the experimentally established neural coding of number magnitude. This is not to say that neural coding of number is the only influence on behavior in these or any other tasks. Instead, the neural coding of number should be considered a foundation from which behaviors arise.

A67

MONITORING INDIVIDUAL AND JOINT ACTION OUTCOMES DURING INTERPERSONAL COORDINATION Janeen Loehr[1], Dimitrios Kourtis[1], Cordula Vesper[1], Natalie Sebanz[1,2], Guenther Knoblich[1,2]; [1]Radboud University Nijmegen, Donders Centre for Brain, Cognition and Behaviour, The Netherlands, [2]Central European University, Budapest, Hungary — When people coordinate their actions with each other to achieve a common goal, they may monitor the joint outcome of their combined actions and/or the specific actions produced by each individual. We investigated these

possibilities using event-related potentials elicited by altered auditory feedback during duet music performance, in which performers may monitor their Own and their Partner's parts for errors that can alter either the Joint action outcome (musical harmony) or Individual action outcomes (specific pitches produced by each performer). Pairs of pianists memorized both parts of a piano duet. Each then performed one part of the duet while their partner performed the other; EEG was recorded from both. The auditory feedback associated with pitches produced by each of the pianists was occasionally altered so that it either a) changed both the pitch and the harmony of the chord to which it belonged (joint outcome) or b) changed the pitch without changing the harmony of the chord (individual outcome). Feedback-related negativities were elicited by alterations of both the joint and individual outcomes, whether they occurred in the own or the partner's part. Pitch alterations that changed the joint outcome elicited stronger error positivities than those that affected the individual outcomes, in both the own and the partner's part. These findings indicate that people monitor both individual and joint outcomes during interpersonal coordination, and that the more salient errors are those that affect the common goal.

A68

MUSIC PROCESSING IN EXPERIENCED DANCERS AND NON-DANCERS: AN EEG SPECTRAL ANALYSIS Constanza Inez de Dios[1], Nicholas J. A. Wan[1], Mari-Anne Rosario[1], Hiroko Nakano[1]; [1]Saint Mary's College of California — This electroencephalographic (EEG) study investigated music processing in experienced Argentine Tango dancers and non-dancers when they listened to preferred music (tango for dancers, jazz/classical for non-dancers) and non-preferred music. EEG at each music condition was analyzed in terms of power percent change from baseline (silence) across seven frequencies: delta, theta, low-alpha, high-alpha, low-beta, high-beta, and gamma. Results showed that regardless of participant group, preferred music elicited stronger power compared to other music in gamma, high-beta, and low-beta, suggesting all participants were attentive in listening to their favored music. Irrespective of group or music type, delta power was greater in anterior than posterior sites, implying participants' internal focus on music. Differences between groups were observed as follows: Listening to their dance music, dancers elicited greater power in low-alpha than non-dancers listening to their jazz/classical music. Dancers' high-alpha power during dance music was positively correlated with years of dance experience. These alpha-band results suggest ease of processing of preferred music in dancers. In high-beta, dancers listening to preferred music showed a region contrast, with lower power in anterior sites than posterior, implying that motor processes were involved in listening to dance music. Finally, male dancers showed more powerful gamma for preferred music than females at the posterior-right region. This could reflect attentive processes of spatial visualization of movement that the leader role requires to initiate dance. Dance experts process tasks related to their expertise such as listening to music in ways distinct from non-experts (i.e., ease of music processing, body movement imagery).

A69

HOW AND WHEN THE MOTOR SYSTEM CONTRIBUTES TO SPEECH PERCEPTION Alessandro D'Ausilio[1], Luciano Fadiga[1,2]; [1]IIT - Italian Institute of Technology, [2]University of Ferrara — Classical models of language consider an antero-posterior distinction between perceptive and productive functions. In the last 15 years, this dichotomy has been weakened because of empirical evidence suggesting a more integrated view. Passive listening to phonemes and syllables activate motor and premotor areas. These activations were somatotopically organized according to the effector recruited in the production of these phonemes. However, a feature of action-perception-theories is that motor areas are considered necessary for perception. In fact, it has been argued that in absence of a stringent determination of a causal role played by motor areas in speech perception, no final conclusion can be drawn in support of motor theories of speech perception. The mere activation of motor areas during listening to speech might be caused by a corollary cortico-cortical connection that has nothing to do with the process of comprehension itself. A possible solution might come from the selective alteration of neural activity in speech motor centers and the evaluation of effects on perception. Therefore, we designed a series of TMS experiments to tackle the causal contribution of motor areas to speech perception. We demonstrated that activity in the motor system is causally related to the discrimination of speech sounds and might be more critical under adverse listening conditions or when coping with inter-speaker variability. Interestingly, this functional association is somatotopically organized according to an effector-sound motor map. Listening to reproducible speech sounds might activate the same motor gestures necessary for production and thus help sensory classification and decision.

A70

I CARE BUT ONLY IF YOU ARE THERE: MOTOR BEHAVIOUR IN OBJECT INTERACTION IS ALTERED BY THE PRESENCE OF AN OWNER. Merryn Constable[1], Ada Kritikos[1], Andrew Bayliss[2]; [1]University of Queensland, [2]University of East Anglia — Ownership is a fundamentally social concept. To navigate our social world we must be able to keep track of our own possessions but appreciate that other objects are owned by other individuals. The importance of ownership in social cognition reveals itself in subtle but consistent motor behaviour during interaction with owned objects. Kinematic data suggest an aversion to interacting with other peoples' things and tendency to take greater care with them (Constable, Kritikos & Bayliss, 2011, Cognition), indicating that ownership affects social action. We sought to determine if these effects are replicable when the owner of the object is known, but absent. Participants reached for and lifted one of three mugs; the participant's own, a confederate's mug, and an unowned mug. Replicating our prior work, participants drew their own mug closer but pushed the confederate's mug away from themselves along a natural 'lift' trajectory. This may indicate a general aversion to interacting with another's mug. However, there was little evidence that greater care was taken with the confederate's mug because no differences between acceleration and deceleration of the mugs in flight were found. These data indicate a dissociation between care taken and an aversion to interact with objects owned by another person. Although ownership is recognised and alters some aspects of behaviour even in the absence of the owner, the social contract to take care of other people's things does not alter motor output unless the owner is present.

A71

OBSERVING SHARED INTENTIONS: AN FMRI INVESTIGATION Terry Eskenazi[1], Shirley-Ann Rueschemeyer[2], Floris de Lange[1], Guenther Knoblich[1,3], Natalie Sebanz[1,3]; [1]Donders Institute for Brain Cognition and Behavior, the Netherlands, [2]University of York, UK, [3]Central European University, Hungary — Action perception studies have so far investigated the perception of individual actions. It is unknown however how we perceive joint actions. Joint actions involve multiple individuals coordinating their actions around a shared intention. According to philosophical accounts of joint action this is fundamentally different from individuals acting in parallel without a shared intention. Do observers process situations where individuals act towards a shared intention (joint action) differently than situations where they act on independent intentions (parallel action)? To answer this question, this fMRI study compared perceptually identical yet intentionally ambiguous actions observed in varying contexts. In an observation paradigm, a dialogue between two individuals set the context for the following video depicting these individuals engaging in various actions. In the joint action condition, the dialogue conveyed two actors agreeing to do something together (making a pizza). In the parallel action condition actors expressed their own independent intentions (pizza/salad). Importantly, the videos following the dialogues were identical. Data analysis focused on the BOLD response during the observation of action performance. Significant activations were observed in the rostral anterior cingulate cortex, the temporal poles and the superior temporal gyri in the joint action condition compared to the parallel action condition. Among these

areas which make up the mentalizing network, rostral ACC has been implicated in engaging in social interactions. Our results suggest that processing shared intentions in observed actions has higher mentalizing demands than processing multiple independent intentions, and that rostral ACC is particularly sensitive to representation of social interactions.

A72

VARYING THE GOAL-DIRECTED PLAUSIBILITY OF OBSERVED ACTIONS CAUSES DIFFERENCES IN MIRROR NEURON SYSTEM ACTIVATION Jonathan Silas[1], Joseph Levy[1], Margot Crossman[1]; [1]University of Roehampton — Some theoretical accounts of human mirror neuron system (MNS) functioning suggest a primary role in understanding the observed actions of other people. Brass et al., (2007) aimed to empirically test this hypothesis by varying the amount of inference required to understand an observed action and measuring the resulting MNS response. They showed that actions observed in a plausible context (e.g., turning on a light-switch with one's knee with occupied hands) compared to those observed in an implausible context (e.g., switching on a light switch with one's knee with unoccupied hands) did not result in a systematic modulation of MNS areas. Given that varying the plausibility of an observed action affects the amount of inference required to understand that action, this finding suggests that MNS areas are not involved in action understanding. In our study, we examine brain activation using fMRI while participants observed videos of a person performing actions that also differed in how plausible they were. In our experiment however, actions varied in plausibility in terms of the goal they achieved. For example, a highly plausible action involved grasping and biting an apple, whereas an implausible action involved grasping an apple and placing it against one's ear. Our analysis of the data reveals that MNS activation is higher for the observation of plausible actions than for implausible ones. We suggest that this demonstrates MNS involvement in action understanding when the inference required is directly related to the goal achieved by the observed action.

LONG-TERM MEMORY: Episodic

A73

THE EFFECTS OF MEMORY REMOTENESS ON RECALL AND RECOGNITION: DEVELOPMENT OF A NOVEL MEASURE OF NATURALISTIC MEMORY Michael Armson[1,2], Brian Levine[1,2]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest Hospital — The Mask Fit Test (MFT) is a procedure required of hospital employees to confirm the type of respiratory mask required to prevent infection. The current study capitalized on this procedure to assess memory for a stereotyped, naturalistic event occurring at a fixed time point. We created a novel test of true-false recognition memory for the MFT at Baycrest that enabled analysis of receiver operating characteristics (ROCs) to derive independent measures of recollection and familiarity. Forty participants who had undergone the MFT at various time points within the last two years were tested. The new measure was validated against the Autobiographical Interview (AI; Levine, 2002), an established measure capable of dissociating elements of episodic and semantic autobiographical memory. We found that scores on the AI for the MFT, as well as scores on our new ROC measure were sensitive to time effects, consistent with the expected rate of forgetting in remote memory. We also found a significant positive correlation between measures of recollection as assessed by the ROC analysis and episodic autobiographical memory as assessed by the AI, supporting the validity of the new measures. This method of assessing remote memory addresses limitations of other measures involving unconstrained remote event selection, including the involvement of heterogeneous events across participants, imprecise memory dating, and a lack of investigation of long-term memories within the one to two year range. Overall, this study suggested that recognition for the MFT and other stereotyped events is a viable method for studying naturalistic memory.

PERCEPTION & ACTION: Other

A74

DISSOCIATING PRACTICE EFFECTS AND LEARNING: EVIDENCE FROM A FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDY. Iris Nikola Knierim[1], Daniel S. Margulies[1], Sonja A. Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Brain activation changes due to practice. Practice with the experimental task increases already within one experimental session. Often, practice also leads to enhanced performance accuracy. However, practice in form of increased task familiarity is not equal to learning. How pure within-session practice reflects on brain activation has not yet been systematically investigated. In contrast, most studies use averaging across the whole session to deal with within-session differences. The current experiment investigated which changes in brain activation occur due to within-session practice when accuracy does not change as a side effect of practice. To address this question, subjects (N = 25) performed a visual pseudoword categorization task within the scanner. During the course of the experiment, subjects completed 400 task trials (divided into 40 blocks). Task blocks were interleaved with blocks of a higher level baseline (240 trials). To assess the effect of task practice on brain activity, we compared brain activation for the first five blocks (task minus baseline) to the activation of the five last blocks (task minus baseline). Our preliminary analyses show more activity in left frontal as well as parietal areas for early task performance compared to late task performance. Accuracy did not differ between the early and the late phases of the experiment. We interpret the differences in brain activity therefor as within-task practice effects. In conclusion, our data suggest that practice effects occur during normal task performance in the absence of behavioural learning.

A75

DECOUPLING CONSCIOUS AND NON-CONSCIOUS EFFECTS ON PLACEBO ANALGESIA Scott Schafer[1], Tor Wager[1]; [1]University of Colorado at Boulder — Previous experience with a treatment (conditioning) and belief that the treatment works (expectancy) are two different mechanisms considered to underlie conditioned pain relief to a placebo treatment. During conditioning, subjects receive painful stimulation in the context of two pharmacologically inert creams: a 'control' cream and a 'treatment' (placebo) cream, delivered with instructions about the cream's strong analgesic properties. Subjects receive higher temperature stimulations with the control cream compared to the placebo cream. Afterward, when tested on identical temperatures, subjects report less pain with the placebo. A combination of non-conscious learning and conscious expectation together give rise to the observed placebo effect, but the relative contribution of each process is unclear. Here, we tested whether conditioned placebo analgesia is expressed even if the participant is made aware that a treatment is a placebo, reversing conscious expectations, and whether persistence of analgesia after expectancy reversal depends on the duration of conditioning. Participants showed significant placebo analgesia after both long conditioning (4 days) and short conditioning (1 day), and placebo analgesia persisted after expectancy reversal only in the long conditioning group, in spite of strong reductions in expected analgesia. These findings demonstrate an important role for non-conscious brain plasticity, as distinct from conscious expectations, in placebo analgesia and related affective learning processes.

A76

MOTOR SYSTEMS OUTPACE PERCEPTUAL SYSTEMS DURING MANUALLY-ASSISTED SEARCH Grayden Solman[1], J Allan Cheyne[1], Daniel Smilek[1]; [1]University of Waterloo, Canada — Recent experiments using a novel search paradigm (the 'Unpacking task') in which observers use the mouse to sort through a 'heap' of items to locate the target, have revealed a surprisingly common error. In this so called 'unpacking error,' observers will select and move the target during search, but fail to recognize it. We present results from several new experiments, using eye-tracking, mouse monitoring, and contingent-visibility manipula-

tions to clarify the causes and consequences of these errors. We confirm that the target is visually inspected prior to the erroneous move, and further resolve the source of the error by demonstrating that the consequences – as indexed by the number of moves following the erroneous rejection – increase with perceptual load. In addition, we analyze detailed movement time-courses, showing that the error movement itself shares the characteristics of typical non-target movements, indicating that the system is operating in a similar fashion when erroneously rejecting a target as when appropriately rejecting non-targets. These results provide further evidence that perception for action and perception for identification can operate relatively independently even in naturalistic contexts, and even in settings like search where they should be expected to act in close coordination. In particular, it appears that the motor processes responsible for unpacking outpace the perceptual processes responsible for recognizing the target. This counterintuitive incoordination provides an important constraint for models of naturalistic action.

A77

DISENTANGLING THE EFFECTS OF EXPECTANCY, AGENCY, AND PERCEIVED CONTROL ON PAIN Liane Schmidt[1], Luka Ruzic[2], Daphna Shohamy[1], Tor D. Wager[2]; [1]Columbia University, [2]University of Colorado — Perceived control over pain, expectancy, and agency are often confounded in their effects on neural processing of painful events and pain experience. For instance, control exercised by means of agency could attenuate the threatening effect of pain. However, as people perceive control they also expect lower pain, and this expectancy strongly attenuates pain as well. In this study we aimed to disentangle these effects. We reasoned that perceived control could directly affect pain or mediate effects of expectancy and agency on pain. Alternatively, expectancy and agency could influence pain independently from perceived control. To address this issue we used a paradigm that varied agency (i.e. choice) and expectancy (i.e. high/low pain probabilities) in a 2x2 design, and measured perceived control and reported pain, respectively. Our results show that pain was not always attenuated when subjects perceived control over it: When the relationship between choice and outcome was uncertain, agency (i.e., having choice) increased pain reports, despite the fact that agency also increased perceived control. In contrast, positive expectations (low expected pain) reduced pain, whether agency was high or low. Thus, we suggest that positive expectancy reduces the aversiveness of negative outcomes, whereas agency in uncertain situations has a polarizing effect, making negative outcomes more aversive. These results are compatible with therapeutic approaches based on acceptance, which involves the voluntary surrender of control.

A78

HUMAN "MIRROR SYSTEM" CAN BE TRAINED TO RESPOND TO ARBITRARY NON-ACTION RELATED OBJECTS Jonathan Venezia[1], William Matchin[1], Gregory Hickok[1]; [1]University of California, Irvine — The mirror neuron theory of action understanding relies on the existence of an observation-execution matching system: observing an action activates the internal motor representation used to produce that action. The system must be action-specific if known actions are to be disambiguated from other, similar actions. This predicts that observed actions produced by different effectors should differentially activate the motor representations corresponding to those effectors. A recent study tested this hypothesis. Participants were shown videos of index and little finger abduction during stimulation of hand motor cortex, and selective facilitation of evoked responses was observed at index and little finger recording sites. However, this effect was reversed by training – subjects who trained to move their index finger while observing little finger abduction showed an enhanced response at the index finger recording site. Here, we extend this finding to arbitrary stimuli. Subjects trained to perform index or little finger abduction in response to viewing particular non-manipulable, stationary objects (cloud or building, direction of training counterbalanced). After training, single-pulse TMS was applied to hand motor cortex during observation of trained stimuli, and motor-evoked potentials (MEPs) were recorded at index and little finger abductors. MEP amplitude was normalized by the response to a baseline stimulus. A preference ratio was constructed for each recording site by dividing the normalized responses to the "train-index" and "train-pinky" stimuli. The difference in preference ratios, indicating muscle-specific modulation of the response, was significant ($P<0.05$). Thus, activation of internal motor representations is not necessarily effector-specific or specific to actions.

A79

SUPPRESSED SEMANTIC INFORMATION ACCELERATES PROBLEM SOLVING. Darya Zabelina[1], Emmanuel Guzman-Martinez[1], Laura Ortega[1], Marcia Grabowecky[1], Mark Beeman[1], Satoru Suzuki[1]; [1]Northwestern University — The present study investigated whether semantic integration depends on awareness. We used compound remote associate (CRA) word problems as a test for semantic integration. In these problems three seemingly unrelated words (e.g., pine, crab, sauce) form a common compound with a single solution word (e.g., apple). During the first three seconds of each trial, the three critical words (or irrelevant words on a control trial) were suppressed from awareness using Continuous Flash Suppression in which the words presented in the non-dominant eye were masked by a strong dynamic mask presented to the dominant eye. The words became visible thereafter and participants attempted to solve the word problem as quickly as possible. If semantic integration occurs without awareness, the problems should be solved faster when the critical words (compared to irrelevant words) were presented during the suppression period.We included catch trials, in which we simulated words breaking through the suppressing mask, to ensure that participants reported any words seen during the suppression period. All trials in which participants saw any words during the suppression period were removed from the analysis. As predicted, the word problems were solved significantly faster when the critical words were presented during the suppression period, $t(11) = -3.12$, $p < .01$. These results demonstrate that when a dynamic mask renders the word problem invisible, the presented words are still processed, and the words are semantically integrated, facilitating subsequent solution rates.

THINKING: Other

A80

CULTURE AND EDUCATION SHAPE THE NEURAL BASES OF INDIVIDUAL DIFFERENCES IN ARITHMETIC SKILL Jiayan Lu[1,2], Jérôme Prado[1], Li Liu[2], Qi Dong[2], Xinlin Zhou[2], James R. Booth[1]; [1]Northwestern University, [2]Beijing Normal University — People differ widely from one another in their mathematical skills, and low achievement has major economic and social costs. In the present study, we examined the neural sources of individual differences in arithmetic, as well as the extent to which those are affected by culture and education. Twenty-seven Chinese and 26 Western participants evaluated single-digit multiplication problems while in a functional magnetic resonance imaging (fMRI) scanner. We found cross-cultural differences in the neural sources of multiplication skills, with behavioral differences in Chinese participants being related to the engagement of left mid-superior temporal and ventral inferior frontal regions that were identified in a verbal processing task. In contrast, behavioral differences in Western participants were related to the engagement of intraparietal and dorsal inferior frontal regions that were identified in a magnitude processing task. These differences are unlikely to result from general cultural differences in numerical processes or problem solving because Chinese and Western participants did not differ in the neural basis of their single digit subtraction skills. Rather, we argue that these results are explained by cultural differences in educational practice with more extensive use of verbal memorization methods during arithmetic learning in China than in Western countries.

A81

DISTANCE MODULATES INTRAPARIETAL SULCUS ACTIVITY WHEN VIEWING FRACTIONS AND DECIMALS Lisa Sprute[1], Donna Coch[1]; [1]Dartmouth College — In the intraparietal sulcus (IPS), activation patterns are more similar for whole numbers that are closer together. There is scant evidence for a similar "distance effect" for representations of fractions, and no studies have examined neural processing of decimals. We used a functional magnetic resonance adaptation (fMRA) paradigm to examine whether distance modulates IPS activity for representations of fractions and decimals. Participants adapted to "one half" presented in black text for 30 s. Six deviant numbers (three distances) were shown as fractions and decimals every 5 to 11 s after the initial adaptation period. Attention was maintained by asking participants to press a button every time they saw a red one half (either as text, a fraction or a decimal). Half of the deviant numbers appeared in red. The effect of distance was examined in a 3 (distance) x 2 (notation) x 2 (color) random effects analysis (N=28; F=13). For comparison to other adaptation studies of whole numbers, a threshold of $p < 0.01$ with a cluster extent of 30 voxels was used. Blood oxygenation-level dependent (BOLD) activity in the right IPS increased with distance but was not modulated by notation or color. Activity in the middle and medial frontal gyri and superior temporal gyrus showed a similar pattern. These findings suggest that both fractions and decimals are automatically represented in a distance-dependent manner, and that processing fractional quantities recruits regions similar to those identified in previous studies of whole numbers.

A82

THE ROLE OF THE RIGHT PARIETAL CORTEX IN CAUSAL PERCEPTION Adam J. Woods[1], Matthew Lehet[1], Anjan Chatterjee[1]; [1]University of Pennsylvania — The ability to infer causality is a central feature of human cognition. Research from our lab shows that people use space or time flexibly when judging causality in billiard-ball-style launching events–a blue ball approaches and contacts a red ball. The spatial trajectories and the temporal delays of the movement of the second ball are parametrically varied in this paradigm. We previously reported that the right parietal cortex (rPC) contributes to spatial aspects of causal perception (Straube & Chatterjee, 2010). We tested the hypothesis that the rPC contributes to perceptual causality because of its role in processing spatial relations. Nine patients with focal rPC injury and 16 healthy young participants were assessed on tasks of elemental spatial and temporal processing, as well as causality judgments. Elemental time and space perception were equivalent in patients (accuracy=69 vs. 67%, $p>.05$). When participants were instructed to attend to either the relative angles (space) or duration of contact between the objects (time) both groups used space or time information to make causality judgments (?2's>4.6, p's<.03). Healthy participants judged smaller angles and shorter time delays as causal when explicitly attending to space or time, respectively (t's>3.0, p's<.009). The patients also used shorter delays to judge causality when explicitly attending to time (t's>2.5, p's<.03), but, they did not change their spatial criteria when asked to attend to space (p's>.05). rPC damage does not effect causal perception by interfering with elemental spatial processing. Rather, rPC damage impairs people's ability to make flexible use of spatial information.

EMOTION & SOCIAL: Emotional responding

A83

INDIVIDUAL DIFFERENCES IN CARDIAC VAGAL TONE MODULATES ERP RESPONSES TO FEARFUL FACES AT LOW SPATIAL FREQUENCY GEWNHI PARK[1], Seung-Hwan Lee[1,2], Eun-Ok Moon[1], Yoon-Jae Moon[1], Sangrae Kim[1]; [1]Clinical Emotion and Cognition Research Laboratory, Goyang, Republic of Korea, [2]1Psychiatry Department, Ilsan Paik Hospital, Inje University, Goyang, Republic of Korea — Objectives: Are individual differences in emotion regulation abilities associated with different neural activity in response to affectively significant stimuli? The present study explored if individual differences in heart rate variability—proposed to be an index of autonomic flexibility and emotional regulation—are associated with different event-related potentials (ERPs) responses to fearful faces at broad, high, and low spatial frequency. Methods: Thirty six healthy participants were asked to discriminate the emotion of fearful and neutral faces at broad, high and low spatial frequency while different ERP components (P100, N100, N170, VPP, N200, N400) were measured. Participants were then divided into two groups, high or low HRV, based on the median split of rMSSD, which is regarded as reflecting primarily vagal activity, during baseline. We compared ERP activity of high and low HRV participants in response to fearful and neutral faces at broad, high and low spatial frequency. Results: Low HRV—characterized by poor functioning of regulatory systems—showed significantly enhanced P100, N100, N200 and N400 components in responses to fearful faces at low spatial frequency, relative to participant with high HRV—characterized by superior self-regulatory functions. Conclusions: The study provided evidence that individual differences in HRV—considered to be an indicator of autonomic, emotional, and attentional self-regulation—is associated with differential ERP responses to fearful faces processed at different neurofunctional pathways. More specifically, enhanced neural activity exhibited by participants in low HRV suggested the dysfunctional processing of fearful faces at low spatial frequency which is primarily processed via a subcortical pathway (retinocollicular–pulvinar–amygdalar).

THINKING: Other

A84

DIFFERENT ACOUSTIC CUES ARE USED BY RUSSIANS AND GERMANS TO DETECT VOICING DIFFERENCES IN SPEECH: EVIDENCE FROM MISMATCH NEGATIVITY Mariya Kharaman[1], Carsten Eulitz[1]; [1]University of Konstanz — Do native speakers of Russian and German use different acoustic cues to distinguish voicing contrasts? It has been argued among linguists that for these languages the traditional distinction into voiced and voiceless stop consonants is based on different laryngeal features. German speakers use [spread glottis], i.e. differentiate between aspirated and unaspirated stop consonants. The Russian native contrast, however, includes stop consonants with negative voice onset time (VOT) and unaspirated stop consonants. To test whether or not different acoustic cues are the basis for categorization, we measured the mismatch negativity (MMN) to study three types of contrasts. CV-syllables used as stimuli included voiceless unaspirated stop consonants, voiceless aspirated stop consonants and voiced stop consonants with negative VOT. We predicted that relying upon native acoustic cues, Russian speakers would perceive voiceless unaspirated stop consonant and voiceless aspirated stop consonants (non-native in Russian) within the category [-voice], whereas German speakers perceive voiceless unaspirated stop consonants and voiced stop consonants with negative VOT (non-native in German) within the category [+voice]. The predicted differential patterning of contrast sensitivity was reflected by the MMN amplitudes. Our results confirmed that during non-native speech perception native speakers categorize non-native stop consonants using their native language-specific acoustic cues.

A85

SEMANTIC PROCESSING OF NUMBER AND SIZE WITHIN THE APPROXIMATE NUMBER SYSTEM Courtney Lussier[1], Jessica F. Cantlon[1]; [1]University of Rochester — Our world presents us with numerical information both symbolically (e.g. number-words) and non-symbolically (e.g. sets of objects). The intraparietal sulcus (IPS) is known to contain regions involved in processing numerical stimuli. However, whether activation related to approximate numerical processing is domain-specific to 'number' or can be elicited by non-numerical magnitude judgment tasks (e.g. size) is currently debated (e.g., Walsh, 2003). Using fMRI, we investigated semantic responses to number and magnitude in brain regions

engaged in non-symbolic number processing. We identified the approximate number system by testing subjects on a numerical judgment task with pairs of dot arrays of differing ratios (0.8 and 0.25) and performed a whole-brain contrast on the numerical ratio effect (0.8 > 0.25). Within those regions, we investigated the levels of activation on a second task: magnitude comparisons and category classifications of number and object words. Subjects indicated if number words were larger/smaller than 15 (magnitude, number) or even/odd (non-magnitude, number), and if the object word was larger/smaller than a cat (magnitude, non-number) or living/nonliving (non-magnitude, non-number). If these IPS regions are involved broadly in judgments of magnitude, the magnitude judgment tasks should produce greater activation in the defined IPS region regardless of stimulus type. However, if they are domain-specific for numbers, we should find greater activation to numerical values independently of task. The data show the latter: significantly greater activation for number stimuli than object stimuli independent of judgment type. This suggests that IPS regions that process approximate numeric stimuli are domain specific to numerical values.

A86

LOOKING UNDER YOUR THINKING CAP: DELIBERATELY TRYING TO THINK MORE CREATIVELY INCREASES FRONTOPOLAR RECRUITMENT. Adam Green[1], Michael Cohen[2], Joseph Kim[3], Jeremy Gray[4]; [1]Georgetown University, [2]UCLA, [3]Vanderbilt University, [4]Yale University — While creativity has been well studied as a static personality trait, the extent to which state creativity can be augmented within an individual is not clear. In addition, the neural mechanisms underlying enhanced state creativity are unknown. Evidence obtained by our group and others indicates that explicit cues can elicit better performance on some creativity-related tasks. Separately, we have found that frontopolar cortex activity increases as participants evaluate and generate analogies that are increasingly creative. Here, we tested the hypotheses that 1) an explicit cue to be creative would elicit more highly creative responses in tasks of verb generation and analogical reasoning, and 2) frontopolar cortex would show increased activation to support increased creativity under the cued condition. For both tasks, event-related fMRI was employed and creativity was quantified using semantic distance, which was calculated using latent semantic analysis. In the verb generation task, the creativity cue elicited generation of verbs that were more semantically distant from the prompt nouns. In the analogy task, the cue elicited more correct identification of semantically distant analogies. For both tasks, an a priori predicted region of frontopolar cortex was significantly more active during the creativity cue. A between-subjects parametric analysis revealed that frontopolar activity in the Cued>Uncued contrast predicted stronger behavioral effects of the cue (i.e., greater differences in semantic distance for cued vs. uncued responses). Results indicate that deliberately trying to think more creatively is generally effective and is supported by increasing recruitment of frontopolar cortex.

A87

INVESTIGATING THE NEURAL BASIS OF SPONTANEOUS THOUGHT WITH FMRI AND CONTEMPLATIVE MENTAL TRAINING Melissa Ellamil[1], Sean Pritchard[2], Evan Thompson[3], Kalina Christoff[1]; [1]University of British Columbia, [2]Fielding Graduate University, [3]University of Toronto — Spontaneous mental processes (e.g., mind wandering, daydreaming, stimulus-independent thought) take up as much as one-third of our waking lives and are thus crucial areas for scientific inquiry. However, there is a lack of methods for their direct, immediate, and reliable observation during neuroimaging experiments. Vipassana or mindfulness meditation, which trains non-reactive, introspective observation of moment-to-moment mental processes, can help provide the more precise information required about the timing and content of spontaneous thoughts. Thus, we used meditators in an fMRI experience sampling paradigm to better examine the neural bases of spontaneous thought. Highly experienced Vipassana meditators practiced mindfulness while in the scanner, and reported via button presses when a thought arose or when a word appeared onscreen and what type of thought or word it was (imagery, narrative, emotion, and body sensation). Relative to reports of word trials, reports of the different types of spontaneously arising thoughts were preceded by enhanced activation of the precuneus, hippocampus, temporopolar cortex, and rostrolateral prefrontal cortex, which are all regions consistently activated in previous spontaneous thought processing and resting state studies. Our results from combining objective neuroimaging measures with subjective reports informed by meditation suggest a more specific role for these regions in the generation of spontaneous thought content.

A88

ALTERED PATTERNS OF NEURAL CONNECTIVITY IN INDIVIDUALS WITH RELAPSING-REMITTING MULTIPLE SCLEROSIS Alisha Janssen[1], Amir Abduljalil[2], Aaron Boster[3], Ruchika Prakash[1]; [1]Department of Psychology, The Ohio State University, [2]The Wright Center for Innovation, The Ohio State University, [3]Department of Neurology, The Ohio State University — Multiple Sclerosis is a neurodegenerative, inflammatory disease of the central nervous system, resulting in physical and cognitive disturbances. Individuals with MS demonstrate altered patterns of cortical recruitment during tasks of exogenous processing, which exhibit further associations with behavioral performance. An important confound in studies of externally directed cognition is the difference in task performance between the clinical sample and healthy controls. Examining resting-state connectivity in individuals with cerebral challenge offers a new way to observe the alterations in the functional architecture of the brain as a result of the disorder. In this study, we examined the coherence of resting-state networks in relapsing-remitting MS patients as compared to a healthy control sample. Fifty individuals with a clinically definite diagnosis of relapsing-remitting MS and thirty age, gender, and education matched healthy controls were recruited for this study. Resting-state data was collected from all participants using standard procedures, and data was analyzed using tensorial ICA. Eight meaningful networks of interest were identified from the ICA results and group differences between MS individuals and healthy controls were examined using a novel technique of dual regression. Areas of significantly reduced coherence in RRMS individuals were found in five of the eight networks including the default mode, fronto-executive, motor, lateral visual, and medial visual networks. Future directions would involve examining the relationship between these areas of reduced synchrony and measures of cognitive performance and disease severity.

A89

ENHANCING MATHEMATICAL LEARNING: CONCURRENT NON-INVASIVE BRAIN STIMULATION AND OPTICAL IMAGING Albert Snowball[1], Tudor Popescu[1], Jacqueline Thompson[1], Ilias Tachtsidis[2], Tingting Zhu[1,2], Margarete Delazer[3], Laura Zamarian[3], Roi Cohen Kadosh[1]; [1]University of Oxford, [2]University College London, [3]Innsbruck Medical University — Mathematical skills are arguably one of the most important cognitive abilities that we must master, with implications on our future income, career options, level of education, as well as mental and physical health. We examined here whether we could enhance arithmetic learning by using transcranial random noise stimulation (TRNS), a non-invasive brain stimulation technique that pushes resting membrane potentials closer to the activation threshold to increase neural tissue excitability. Five consecutive days of TRNS was applied to the dorsolateral prefrontal cortex while 25 subjects learned to solve arithmetic problems. We uniquely coupled the TRNS-cognitive training with concurrent near-infrared spectroscopy (NIRS) recordings to examine the local and remote changes in oxygenated, deoxygenated and total haemoglobin concentrations that are associated with numerical learning and TRNS. Compared to sham stimulation, TRNS both enhanced numerical performance, as indicated by the learning rate, and reduced response time when increasing the cognitive load. TRNS did not, however, improve the performance in control tasks used to quantify executive functions. At the neural level, compared to sham, TRNS facilitated the time-to-peak onset of oxygenated haemoglobin rises at the site of stimulation but not in remote brain areas. These results reveal that TRNS can be used to enhance arithmetic learn-

ing by facilitating neural excitation, resulting in the earlier availability of energy substrates, such as oxygen, within the region of stimulation. These findings provide a first step to use TRNS to enhance numerical learning in individuals with mathematical learning difficulties.

A90

BRAIN STRUCTURE OF CREATIVE EXPLORATION: CAUDATE VOLUME PREDICTS DIVERGENT THINKING AND TRAITS RELATED TO COGNITIVE EXPLORATION Rachael Grazioplene[1], Colin G DeYoung[1], Matthew Russell[2], Jeremy Gray[3]; [1]University of Minnesota, [2]University of Alberta, [3]Yale University — It has been theorized that the neurotransmitter dopamine is involved in divergent thinking ability (Deitrich, 2004) Sensation Seeking (Zald, 2010) and plasticity (the Big Five metatrait which includes Extraversion and Openness; DeYoung et al., 2006). The striatum is heavily involved in dopaminergic neurotransmission, and caudate volume has been linked to variation in dopamine genes (Stein, 2011). A positive association has been identified between caudate volume and creativity (Takeuchi et al., 2010). We hypothesized that caudate volume would be associated with divergent thinking scores; we also predicted that, if dopamine function in the striatum represents an underlying connection between divergent thinking and cognitive exploration, caudate volume would also be associated with Sensation Seeking and Plasticity. Analyses of the relation of these constructs to caudate volume were performed in a group of 107 healthy male adults aged 20-40 years. Regression analyses revealed that caudate volume was significantly associated with divergent thinking scores. Caudate volume was also associated with Sensation Seeking the Assertiveness facet of Extraversion, and the Intellect Facet of Openness/Intellect (controlling for IQ). The present research suggests that individual differences in brain regions tightly tied to dopamine function are predictive of divergent thinking ability. Additionally, the relation of caudate volume to the Big Five aspects Assertiveness and Intellect (aspects of Extraversion and Openness/Intellect, respectively) suggests that variation in caudate accounts for variation in both divergent thinking and traits related to cognitive exploration, perhaps pointing to a role for the caudate in the general facilitation cognitive and behavioral flexibility.

THINKING: Problem solving

A91

EDUCATION-DEPENDENT BRAIN PLASTICITY: FRONTAL-PARIETAL MECHANISMS FOR LINKING QUANTITIES AND SYMBOLS DURING THE ELEMENTARY SCHOOL YEARS Edward Hubbard[1], Bruce McCandliss[1]; [1]Vanderbilt University — Mounting evidence supports the notion that children's mastery of arithmetic is founded upon more elementary forms of number cognition, including the ability to automatically translate between number symbols and the quantities that they represent (e.g., 5 = :•:). Although brain circuits that are sensitive to quantity have been identified in very young children, the acquisition of symbolic numbers may refine these circuits as they learn to recognize and automatically link Arabic digits to quantities. To examine the neural development of these links, we measured fMRI responses in 63 children in grades K-3. Arrays of dots of a standard quantity (6 or 8) were presented repeatedly, alternating with rare deviants that were either numerically close to or far from the standard (5 or 9) in either the same format (dots) or a different format (digits). We identified two distinct processes linking math fluency to developmental changes in brain responses. Regions in frontal and parietal cortex responded to digits in a context-dependent manner: responses to far deviants were larger than responses to close deviants, across all children. Frontal and anterior IPS regions showed decreasing context-dependent responses with increasing age and math skills, suggesting that increasing math skill is related to decreased recruitment of these regions. Conversely, context-independent responses in posterior parietal and frontal regions increased with age and math skills, suggesting that the degree to which children have constructed context-dependent and context-independent neural circuits for exact number may be critical for explaining individual differences in learning formal arithmetic.

A92

VERBAL CREATIVITY AND ALPHA: A BRAIN WAVE ENTRAINMENT STUDY Polly O'Rourke[1], Timothy George[1], Alexei Smaliy[1], Kristin Grunewald[1], Joseph Dien[1], Henk Haarmann[1]; [1]University of Maryland — Increases in alpha power in the right hemisphere are associated with cognitive disengagement and increased creativity (Grabner et al. 2007). The goal of the current study was to determine if increasing alpha power via brain wave entrainment (consisting of acoustic beats presented at a rate of 10 Hz) would improve performance on a verbal creativity task. EEG was recorded while participants in both an entrainment and control group performed the insight task in which they were presented with a scenario ("a light in the darkness") and asked to generate as many explanations as possible and to be creative in their responses. Self-rated originality of each response and fluency (total number of responses per item) were used as measures of creativity. The key predictions were that the alpha entrainment group would show greater creativity and increased event-related synchrony (ERS) in the alpha band relative to controls. While no group differences were found in self-rated originality, analysis of the fluency data showed that the control group had greater verbal fluency than the entrainment group. During task performance, the control group had reduced alpha ERS in the left hemisphere indicating increased engagement. No hemispheric effects were found in the entrainment group. The results suggest that alpha entrainment inhibits engagement of speech and language areas in the left hemisphere, resulting in reduced verbal fluency. Future studies examining the relationship between alpha power and performance in verbal creativity tasks must consider the differential contributions of the two hemispheres.

A93

AUTOMATICITY IN PROCESSING OF NUMBERS THAT WERE NEVER PRESENTED: AN FMRI STUDY Arava Y. Kallai[1], Christian D. Schunn[1], Julie Fiez[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition — The horizontal section of the intra-parietal sulci (hIPS) was previously identified as specializing in number-related processing and was associated with analogic representation of numbers. Neurons in that region were identified as being sensitive to specific numerical value, exhibiting a distance effect (i.e., decreasing activation when the distance between the presented numerosity and the preferred numerosity for that neuron grew larger) (Nieder & Miller, 2004; Piazza et al., 2004). Piazza et al. (2007) further showed that such sensitivity is notation-independent: adaptation to Arabic numerals or non-symbolic quantities showed distance sensitive dishabituation for deviants from either notation. A stronger test of the general numerosity content of the analogic representations would be to show adaptation to quantities never presented (i.e., generated internally). In an adaptation fMRI study, the spontaneous processing of arithmetical expressions was tested. Participants passively viewed addition expressions, made of two double-digit numbers, which summed to the same number within a run. Adaptation was found in number-related regions in a fronto-parietal network. Following adaptation, deviants comprised of array of dots were introduced. Activation in voxels that showed linear decrease during the adaptation period was sensitive to the distance of the number of dots from the sum of the addition expressions. We conclude that participants were adapted to a number (sum) that was created internally but was never presented externally. Given the difference in notation of the standard and deviant stimuli, we suggest that adaptation was to an analogic representation of the quantity represented by the sum of the addends.

A94

LOOKING OUTSIDE THE BOX: BLINKS AND EYE MOVEMENTS ASSOCIATED WITH INSIGHT VERSUS ANALYTIC PROBLEM SOLVING Carola Salvi[1], Steve Franconeri[2], Emanuela Bricolo[1], John Kounios[3], Mark Beeman[2]; [1]Milano-Bicocca University, [2]Northwestern University, [3]Drexel University — Previous studies have demonstrated distinct patterns of activity in occipital cortex for solving verbal problems via insight compared to solving analytically, both immediately prior to solution and in rest periods before each problem is presented. Here, we examined eye movement and eye blink patterns associated with the two different problem-solving styles. Participants attempted to solve 120 Compound Remote Associate (CRA) word problems within 15 seconds each, and after each solution indicated whether they had solved it through insight or analysis. Eye movements were recorded before the problem appeared and while it was on the screen. In accordance with previous behavioral and neuroimaging research, eye movement and blink patterns varied by problem solving style. Specifically, made more frequent and longer-lasting blinks during the two second preparatory period before seeing problems that they subsequently solved with insight, compared to problems they subsequently solved analytically. In the two second period immediately prior to solution, participants blinked longer and made fewer fixations in the problem area prior to solving with insight than prior to solving analytically. Consistent with other studies, these results suggest that insight involves and is facilitated by a mechanism oriented to avoid external inputs, and direct attention inward, suggesting that internal versus external directed visual attention might contribute to the two solving styles.

A95

NEURAL CORRELATES OF MATHEMATICAL COMPETENCE: PARIETAL BRAIN ACTIVATION DURING SINGLE DIGIT ARITHMETIC PREDICTS PERFORMANCE ON PSAT MATH TEST Price Gavin[1], Mazzocco Michele[2], Ansari Daniel[1]; [1]University of Western Ontario, [2]Johns Hopkins University — Acquiring basic arithmetic skill is a crucial prerequisite for successful participation in modern society, and low mathematical competence has severe consequences at the individual and societal levels. However, the sources of individual variation in mathematical competence are poorly understood. The present functional magnetic resonance imaging (fMRI) study investigated in 32 participants, the relationship between the brain activation during arithmetic verification, recorded at grade 12, and performance on a standardized national measure of college level mathematics aptitude (PSAT Math, which includes word problems, geometry, algebraic equations, and arithmetic), recorded at grade 10. Results reveal a negative correlation between PSAT Math standard scores and calculation related activity in the right intraparietal sulcus (IPS), a suggested neural substrate of the 'Approximate Number Sense' (ANS). Furthermore, psychophysiological interaction analysis (PPI) revealed a negative correlation between calculation activation in the right IPS and the bilateral parahippocampal gyrus, suggesting orthogonal engagement of calculation versus memory retrieval mechanisms during single digit arithmetic. Participants also completed a nonsymbolic numerical comparison task in the scanner, revealing a significant parametric effect of ratio on activation in the same IPS region reported above, confirming the involvement of quantity processing mechanisms in the relationship between calculation activation and PSAT math scores. These results suggest that individuals who do not shift from procedural to fact retrieval calculation strategies show poorer outcomes on educationally relevant, independently measured, mathematical competence measures, and that these outcomes can be predicted by relative engagement of neural ANS mechanisms during single digit arithmetic.

A96

RODENT MODEL OF THE EFFECT OF BETA-ADRENERGIC AGENTS ON CREATIVE PROBLEM SOLVING Patrick Hecht[1], Matthew Will[1], Todd Schachtman[1], Bradley Ferguson[1], Jill Hampton[2], Lauren Welby[1], Julian Deville[1], David Beversdorf[1]; [1]University of Missouri- Columbia, [2]Truman State University — Previous research revealed benefit from ?-adrenergic antagonists in creative problem solving. However, animal models have exclusively explored set shifting tasks, where ?-1 adrenergic and dopaminergic, but not ?-adrenergic effects have been found. To address this gap, we developed a novel creative problem solving task in rodents and examined the effect of propranolol. Rats were first trained to dig for food in three reward pots. They were then trained in odor discrimination and medium discrimination. Then, after administration of 1mg/kg propranolol or placebo, the rats were tested on simple discrimination, compound discrimination, reversal learning, and set shifting, using the 2 side reward pots. During these tasks, the digging chamber in the middle was blocked off. Then, the digging chamber was filled with sawdust, the entrance to the digging chamber was unblocked, and the reward was moved from the side pots to the end of the digging chamber, such that the rats were required to generate the novel solution to this problem by digging through the sawdust to access the reward pot. Preliminary data revealed no effect of propranolol on any of the reversal learning or set shifting tasks. However, performance on propranolol was found to be better as compared to placebo for the novel digging task as assessed by time to completion. This is, to our knowledge, the first rodent model of creative problem solving, allowing for the possibility of examination of the mechanism of action of this process in a way not possible with most other organisms.

A97

A CUSTOMIZED ARITHMETIC PROGRAM FOR USE IN FUNCTIONAL NEUROIMAGING EXPERIMENTS Christian Battista[1], Daniel Ansari[1], J Bruce Morton[1]; [1]University of Western Ontario — Most functional neuroimaging studies use the same trials to estimate brain activation across participants. This can be problematic when the strategies used to respond to experimental trials differ between individuals. It has recently been established that brain activation during an arithmetic tasks depends heavily on the problem strategies used. Memorized problems involve parietal regions like the left angular gyrus, whereas problems that require the use of procedural problem-solving strategies induce widespread prefrontal activation (Grabner et al., 2009). Given these differences in brain activation associated with arithmetic strategies it is important to carefully control for the strategies that individuals use during arithmetic problem solving. Researchers should customize the set of problems that are being presented to the individual's ability level and thus control for variability in strategy use, particularly when comparing groups with different proficiencies. To facilitate this, a customized arithmetic (CA) program was developed. Participants were shown a series of addition problems and asked to identify the solution. Following response, they indicated which strategy they used to solve the problem. Examinations of both reliability and validity of self-reports were favourable, with good agreement between self-reports, and a tendency for memorized problems to be solved more quickly than calculated problems. This demonstrates that self-reported strategy can be successfully used to create individually tailored problem sets. These problem sets should be used in investigations of mental arithmetic, particularly those which compare arithmetic performance in people with different skill levels. The CA program can be obtained by contacting the first author.

A98

INSIGHT FOLLOWS INCUBATION IN THE REMOTE ASSOCIATES TEST Stephanie Hare[1], John Molony[1], Sean McCarthy[1], Kelly Brandstatt[1], Leonidas Skiadopoulos[1], Krishna L Bharani[1], Robert G Morrison[1]; [1]Loyola University Chicago — Problem solving through insight differs from traditional trial and error strategies in that problem solvers experience an impasse (e.g., fixation) prior to a sudden conscious awareness of an answer of which they are confident. Various studies of insight problem solving suggest that a period of time away from the problem (i.e., incubation) can sometimes help overcome problem fixation. In this study we use a Remote Associates Test in which the solution time is divided into two epochs. On

some trials the second epoch is preceded by a brief incubation period during which the participants performed a simple working memory distractor task. When participants solved a problem they were asked to report whether they experienced insight. 20 of 36 participants solved at least one problem during the second epoch. While second epoch solution rates did not differ based on whether participants incubated or not, participants who solved problems during the second epoch reported significantly more experiences of insight after an incubation period. We discuss this result with respect to recent neuroimaging studies detailing the neural correlates of insight.

A99

MEMORY UPDATING CAPACITY IS THE BETTER PREDICTOR OF MULTIPLICATION PERFORMANCE THAN NUMERICAL ACUITY. Cheng-Ching Han[1], Nai-Shing Yen[1], Daniele Didino[2], Brian Butterworth[2]; [1]National Chengchi University, Taipei, Taiwan, [2]University College London, London, UK — It has been claimed that approximate numerosity system (ANS) is a foundational for learning arithmetic. In particular, "numerical acuity", individual differences in the ability to discriminate the numerosities of two visual displays, predicts arithmetical ability. Here we assessed whether capacity on this ANS task predicts arithmetical performance as compared with measures of working memory capacity. Forty-seven college students to participated in tasks that evaluate (1) general cognitive activities (four working memory tests that included memory updating, operation span, sentence span, and spatial short-term memory), (2) numerical acuity, and (3) multiplication performance. Participants who performed well in multiplication task had higher accuracy rates and shorter reaction times than low performing ones; these two groups also showed different calculation strategies. There are two methods to work through the multiplicand. One is from right to left, and the other is from left to right. The later method was used to solve multiplication problems in the high performing group more (more than 63% trials) than the low performing group (less than 21% trials). Multiplication performance is highly correlated with working memory capacities. Participants with good performance in memory updating test performed better in multiplication test. Performances between approximate number system and multiplication tasks were only weakly correlated. Comparisons between working memory tests and approximate number system task to multiplication performance had suggested working memory capacity, especially the memory updating capacity, was a better predictor for multiplication performance. The present study thus concluded executive function is more crucial for arithmetic learning.

A100

GREY MATTER DENSITY IN INDIVIDUALS WITH HIGHER CREATIVITY: A VOXEL BASED MORPHOMETRY STUDY Joseph Frantz[1], Sephira G. Ryman[2], Ranee A. Flores[2], Rex E. Jung[2]; [1]Mind Research Network, Albuquerque, NM, [2]University of New Mexico Health Sciences Center–Department of Neurosurgery — Recent theoretical models (Dietrich, 2004; Flaherty, 2011; Heilman, et al., 2003) as well reviews (Arden et al., 2010; Dietrich & Kanso, 2010) support involvement of frontal and temporal regions underlying creative idea generation and drive. Lesion studies also show increased creative output in select patients with frontal and temporal lobe damage (Miller et al., 2000). We hypothesized that frontal and temporal gray matter volume would relate to creative capacity in normal, healthy subjects. Creativity was assessed in 130 subjects via Divergent thinking (DT) measures, scored by a panel of peer judges on the quality of creative responses, using the Consensual Assessment Technique, and compiled into a "Composite Creativity Index" (CCI). We utilized optimized Voxel-based morpohometry (VBM) to determine the relationship between CCI scores and grey matter volume, covarying for total grey matter, IQ, and age. Significant inverse relationships were observed between grey matter density and CCI scores within bilateral inferior frontal gyri and bilateral hippocampus, ($p < 0.001$ uncorrected). This inverse correlation between CCI scores and the inferior frontal gyrus were consistent with a frontotemporal model of creativity; the significant correlation to the hippocampus was unexpected. Mood disorders have been found to be associated with higher incidence of creativity. In severe cases of depression and post traumatic stress disorder, lower gray matter volume is seen in the frontal lobe and hippocampus (Tischler, et al., 2006). While none of our healthy subjects presented with mood dysfunction, the current results suggests a continuum of frontotemporal volume decreases associated with creative capacity.

A101

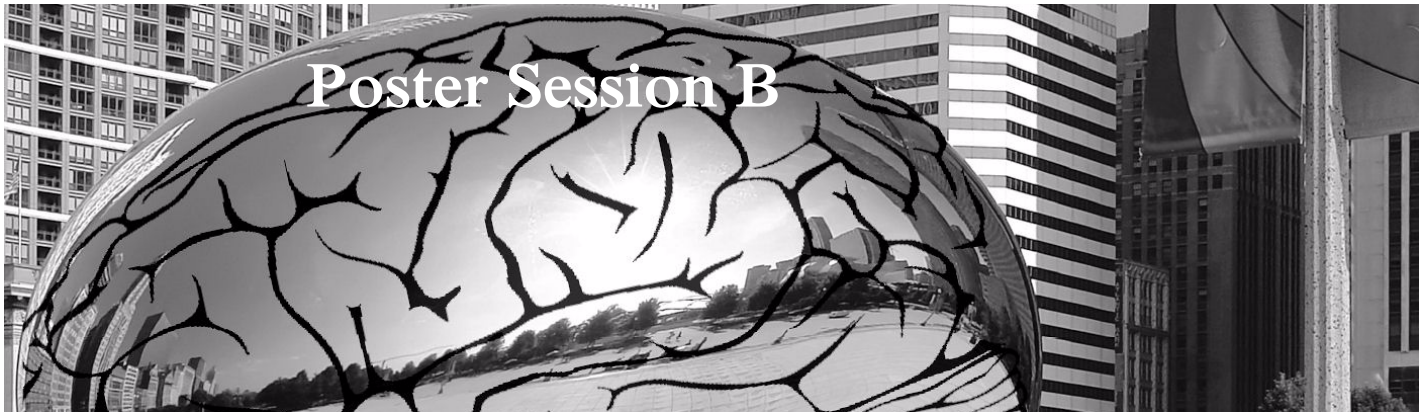
UNDERSTANDING THE NEURAL BASIS OF CREATIVE COGNITION: NEUROPSYCHOLOGICAL AND NEUROIMAGING EVIDENCE Naama Mayseless[1], Simone Shamay-Tsoory[1]; [1]Dep. of Psychology, University of Haifa, Haifa, Israel — Based on the twofold model of creativity according to which creativity involves an "idea generation" and an "idea evaluation" phase, we sought to examine the hypothesis that the neural network mediating creativity involves interaction between an idea generation system (medial prefrontal cortex-mPFC and posterior parietal cortex - PPC) and an evaluation system (left temporoparietal junction -TPJ, left inferior frontal gyrus- IFG). To test this hypothesis we assessed creative abilities of healthy subjects who were further scanned while performing a modified version of the Alternate Uses Task, which examines the generation of original ideas as well as the evaluation of original ideas generated by other subjects. Evaluation of originality engaged left frontal and parietal regions including the left TPJ (BA 39) while generation of creative ideas engaged areas in the Anterior Cingulate (bilateral) and the Posterior Cingulate (bilateral). Additionally, beta values in the left TPJ were negatively correlated with fluency scores of a different creativity task (the Torrance Circle subset of the TTCT, Torrance Tests for Creative Thinking, 2007), indicating that the larger the activation in left TPJ the fewer answers given in the TTCT. Taken together, these findings demonstrate the existence of two dissociable neural networks that contribute to the creative process, a left lateralized evaluation system and a medial generation system. These findings are largely supported by recent neuropsychological evidence of enhanced creativity in patients with frontotemporal dementia.

A102

RELATIONSHIP BETWEEN CREATIVITY PERFORMANCE, SELF-REPORTED CREATIVE ATTRIBUTES, AND FINE MOTOR CONTROL: POTENTIAL RELATIONSHIP WITH DOPAMINERGIC ACTIVITY Bradley Ferguson[1], Aiden Lee[1], Kristi Stringer[2], David Beversdorf[1], Paul Foster[3]; [1]University of Missouri-Columbia, [2]University of Alabama-Birmingham, [3]Middle Tennessee State University — Spreading activation in the brain, a critical aspect of creative thought, has been shown to increase as levels of the neurotransmitter dopamine decrease. Furthermore, dopamine is involved in the modulation of motor movements. Specifically, rates of finger tapping covary positively with dopamine levels as well as dopamine D2 receptor density in the brain. Therefore, it is possible that a relationship exists between dopamine (as estimated by finger tapping), spreading activation, and creativity. Previous research suggests that and inverted U-shaped relationship exists between spontaneous eye blink rate, which has been shown to be sensitive to dopamine levels, and cognitive flexibility on a divergent thinking task. Consistent with the aforementioned finding, we hypothesized that an inverted U-shaped relationship would exist between rates of finger tapping and performance on creativity tasks. Further, we predicted that this relationship would also exist between rates of finger tapping and self-reported attributes and behaviors associated with creative individuals, as we previously found this measure to correlate with performance on a standardized measure of creativity. For the current study, participants completed a finger tapping test, measures of creative performance, and questionnaires assessing behaviors commonly associated with creative individuals, handedness, and current mood. Indeed, our results indicated that an inverted U-shaped relationship exists between finger tapping score and creativity. These results begin to suggest that a relationship may exist between creativity and behavioral correlates of dopaminergic functioning.

A103

TRANSFER OF ABSTRACT ACTION RULES DURING REINFORCEMENT LEARNING James Brew[1], Michael J. Frank[1,2], David Badre[1,2]; [1]Brown University, [2]Brown Institute for Brain Sciences — Often, we must behave appropriately in circumstances that are novel, but nevertheless share deep analogy to situations we already understand. In such cases, we can apply previously successful rules for action to achieve our goals. This ability is termed positive transfer and is thought to underlie reasoning and adaptive behavior. However, the neural systems supporting transfer are not well understood. Here, we sought to investigate transfer of abstract rules. Through reinforcement, participants learned rules that mapped visual stimuli to responses in two learning sessions. Superficial mappings between stimulus features and responses changed between sessions, making concrete rules novel in the second session. Following prior work (Badre et al., 2010), either concrete rules had to be learned individually (flat structure) or an abstract rule could be used for efficient generalization (hierarchical structure). Participants received the flat or hierarchical structure in the first session, followed by either the same structure or the other one in the second session. Across several behavioral metrics, learning of a hierarchical structure in the second session was facilitated only when preceded by a hierarchical structure in the first session, providing evidence of transfer. We next applied a previously developed computational model (Frank and Badre, in press) to estimate a subject's latent hypotheses about rule structure based on her/his specific sequence of responses. This analysis specified that prior exposure to a hierarchical rule structure encouraged search for this rule during subsequent learning. These results have implications for theories of hierarchical fronto-striatal organization during learning and cognitive control.



Sunday, April 1, 8:00 - 10:00 am, Exhibit Hall

ATTENTION: Development & aging

B1

AGE-RELATED CHANGES IN SELECTIVE ATTENTION IN THE VERY OLD: A BOTTOM-UP OR TOP-DOWN PROBLEM? Tatyana Zhuravleva[1], Anna Haring[1], Brittany Alperin[1], Phillip Holcomb[2], Dorene Rentz[1], Kirk Daffner[1]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — Previous research has demonstrated age-related deficits in selective attention, which have been attributed to declines in top-down control mechanisms. Such theories would predict greater impairment of selective attention under more demanding conditions, which consume capacity-limited resources. The current study expanded previous research by including a large sample of 80+ year-olds. ERPs were recorded in 15 young-old (65-79) and 23 old-old (80-99) subjects with high executive capacity during a color-selective attention task. Subjects responded to target letters in a specified color (Attend) while ignoring letters in a different color (Ignore). The task was completed under both low (1 target letter) and high (4 target letters) memory load. There was a marginal decrease in accuracy for the old-old group, but no group differences in RT. There were no latency differences between groups for early ERP components (P1, N1, Selection Positivity, Selection Negativity). Under both memory loads, the old-old group showed a reduction in preliminary visual discrimination, as indexed by the posterior N1. Old-old subjects also demonstrated a marked decrease in selective modulation of attention to features, as indexed by the posterior Selection Negativity, generating no differences between Attend and Ignore conditions. In contrast, there were no group differences in frontally-mediated selective modulation, as indexed by the anterior Selection Positivity, regardless of memory load. The current findings pose a challenge to the top-down, inhibitory-deficit hypothesis of aging by suggesting that age-related degradation of early visual processing, and not executive control mechanisms, are largely responsible for deficits in selective attention to color.

B2

AGE-RELATED CHANGES IN THE PROCESSING OF TO-BE-IGNORED STIMULI: PRESERVED SELECTIVE ATTENTION DOES NOT PREVENT SUBSEQUENT ALLOCATION OF EXCESSIVE PROCESSING RESOURCES Brittany Alperin[1], Anna Haring[1], Tatyana Zhuravleva[1], Phillip Holcomb[2], Dorene Rentz[1], Kirk Daffner[1]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — A critical mechanism for conserving capacity-limited resources and efficiently carrying out task demands is to limit the allocation of resources to stimuli that are supposed to be ignored. This study investigated age-related changes in attentional operations involved in the processing of to-be-ignored stimuli. ERPs were measured in 12 young (mean age 23) and 15 old (mean age 74) well-matched adults during a color-selective attention task. Subjects responded to target letters in a specified color (Attend) while ignoring letters in a different color (Ignore). There were minimal age-associated differences in selective attention (Attend-Ignore), as indexed by the size of the posterior Selection Negativity (SN) and anterior Selection positivity (SP). In striking contrast to their younger counterparts, old subjects appropriated a similar amount of resources to targets under the Attend and Ignore conditions for operations involved with orienting and decision-making, as measured by the size of the P3a and P3b components. Old subjects also exhibited prolonged latencies of the SP, SN, P3a, and P3b, suggesting delays in carrying out pertinent operations. In summary, despite the relative preservation of early selective attention, old subjects appropriated substantially more controlled processing resources in response to target-like stimuli under Ignore. Although inefficiencies in selective attention may undermine the quality of information available for subsequent operations, they do not fully account for the increased allocation of resources in response to to-be-ignored targets. One consequence of this age-related deficit is that older adults are at high risk for running out of processing resources to manage increased task demands.

B3

SENSORY-PERCEPTUAL ENCODING AND SELECTIVE ATTENTION: AN EXAMINATION OF PROCESSING SPEED AND INHIBITION AMONG WELL-MATCHED YOUNG AND YOUNG-OLD ADULTS Anna Haring[1], Tatyana Zhuravleva[1], Brittany Alperin[1], Phillip Holcomb[2], Dorene Rentz[1], Kirk Daffner[1]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — This study addressed limitations in electrophysiological research on age-related changes in selective attention by 1) matching age groups for executive capacity and performance, 2) employing experimental conditions to distinguish mechanisms of neural enhancement and suppression, and 3) examining the relationship between sensory-perceptual encoding and selective attention. ERPs were measured in 12 young (mean age 23) and 15 old (mean age 74) adults. Subjects identified target letters under a color-selective attention task requiring responses to the Attend (A) but not the Ignore (I) color, and a color-neutral (N) attention task in which color was not task-relevant. Old subjects had lower task demands (fewer target letters). There were no group differences in accuracy or RT. Old subjects exhibited delayed sensory-perceptual encoding (P1 latency). The magnitude of selective attention modulation between Attend and Ignore did not differ between groups, indexed by the size of the posterior Selection Negativity (SN) and anterior Selection Positivity (SP). However, unlike young subjects, old subjects did not exhibit reduction in neural activity under the Ignore relative to Neutral condition. Age-related delays in SN latency and lack of suppression under Ignore were not predicted by differences in P1 latency. In summary, this carefully matched sample demonstrates that older adults execute selective attention processes less efficiently than their younger counterparts, failing to suppress activity under the Ignore condition. Although there are age-related delays in sensory-perceptual encoding, they do not account for subsequent delays in posterior selective attention operations or in the reduced ability to inhibit the processing of to-be-ignored stimuli.

B4

NEURAL SUBSTRATES OF AGE-RELATED IMPAIRMENTS IN VISUAL SELECTIVE ATTENTION Franziska Labrenz[1], Maria Themann[2], Edmund Wascher[2], Bettina Pfleiderer[3], Christian Beste[1]; [1]Institute for Cognitive

Neuroscience, Biopsychology, Ruhr-University Bochum, [2]Leibniz Research Centre for Working Environment and Human Factors, TU Dortmund, [3]Department of Clinical Radiology, University of Muenster — In the course of demographic development, the topic of aging has taken on greater significance in neurocognitive research. Impairments in cognitive abilities of older adults are a well-documented phenomenon and a substantial body of research has revealed performance deficits in a wide range of cognitive functions. Especially attentional processes are vulnerable to the effects of aging in the sense of older people being more sensitive to interference from task-irrelevant information. Accordingly, older adults reveal an inability to effectively suppress neural activity associated with distracting bottom-up information. Therefore, the question arises as to how the suppression of a concomitant distractor along with a behaviorally relevant target stimulus varies dependent on age and how these differences are reflected neurally. We conducted an fMRI study using a biased competition paradigm in which two bars changed either luminance and/or orientation separately or simultaneously at the same location (non-conflict) or at opposite locations (conflict). Subjects (N=38) were instructed to respond to luminance changes only and to ignore changes of orientation. Behavioral results indicated that older adults performed overall more erroneously than younger adults. Neuroimaging results revealed that older adults exhibited activation in additional brain areas and higher activation in fronto-parietal sites than younger adults. Hence, our data suggests that older people are functionally deficient in regions mediating top-down attentional control. These results may indicate that older people overactivate brain areas to compensate for declining efficiency and beyond, to obtain an equivalent level of proficiency.

B5

THE EFFECTS OF AGE, TASK DEMANDS, AND AUDITORY CUES ON VISUAL SELECTIVE ATTENTION Paula McLaughlin[1], Jill Rich[1,2], Nicole Anderson[3,4], Susan Murtha[1]; [1]York University, [2]Baycrest Centre, [3]Kunin-Lunenfeld Applied Research Unit, Baycrest Centre, [4]University of Toronto — The ability to selectively attend to information in the environment is a complex skill used each day. Previous research has demonstrated that this ability declines with age, particularly under difficult conditions where executive processing is required. However, by manipulating different environmental factors, age-related declines in visual selective attention may be exacerbated or ameliorated. The present study explored how visual selective attention changes across the adult lifespan, and examined whether age-related declines can be mitigated with auditory cues. Young (ages 18-25), middle-aged (ages 40-54), and older (ages 65-82) participants were administered a cued choice reaction time (RT) task that became progressively more demanding. This was achieved by increasing the level of processing from simple response-location compatibility to conflict resolution and by varying the number of test stimuli. Age-related differences in selective attention emerged when the task required more executive components of attention. These aging effects were evident in the middle-aged group, albeit to a lesser extent than in the older group. Furthermore, performance significantly improved when participants were provided with an informative auditory cue that spatially oriented attention. These cueing effects were larger in the simplest condition, and the older participants benefit more from the auditory cues relative to the young and middle-aged groups. In sum, age-related deficiencies in selective attention were associated with conflict resolution, response suppression, and working memory. These findings support the frontal hypothesis of aging, which states that age-related differences on various tasks are associated with declines in executive processing, and extend this hypothesis to middle-aged adults.

B6

ATTENTION NETWORKS IN AUTISM SPECTRUM DISORDERS: A FUNCTIONAL CONNECTIVITY MRI STUDY Merage Ghane[1], Aarti Nair[1], Brandon Keehn[1,2,3], Chris Keown[1], Patti Shih[1,4], Jeanne Townsend[3], Ralph-Axel Mueller[1]; [1]San Diego State University, [2]Harvard Medical School, [3]University of California San Diego, [4]Brown University — Individuals with Autism Spectrum Disorder (ASD) show pervasive abnormalities of attention (Allen & Courchesne, 2001). Suppositions have been made that atypical attention modulation may contribute to the development of socio-communicative deficits in ASD. It has been suggested that attention is organized into three functionally separate but interrelated networks: alerting, orienting, and executive control networks (Posner & Rothbart, 2007). The present study used resting state functional connectivity MRI (fcMRI) to assess connectivity between network regions and the Attention Network Test (ANT) to examine network efficiency. Participants were 17 adolescents with ASD and 23 typically developing (TD) individuals. Group comparisons showed clusters of underconnectivity in the alerting and orienting networks for ASD adolescents compared to the TD group. In subsamples of participants with ANT scores, there was a positive correlation between functional connectivity between regions of the orienting network and executive control efficiency measured with the ANT in the ASD group ($r = .80$, $p = .03$), but not in TD individuals. These results are consistent with previous studies showing atypical interdependence between attention networks in ASD (Keehn et al., 2010). Additionally, alerting network efficiency was positively correlated with ADI diagnostic scores for social interaction and communication and language in the ASD group ($r = .60$, $p = .02$ and $r = .58$, $p = .03$). ADOS scores for repetitive/restrictive behaviors positively correlated with executive control functional connectivity ($r = .552$, $p = .041$). Our findings provide further evidence for attention dysfunction in ASD and its relationship to socio-communicative dysfunction.

B7

AUDITORY TEMPORAL PROCESSING IN OLDER ADULTS: DIMINISHED ATTENTION MODULATION WITH STRUCTURAL DECLINES Kelly C. Harris[1], Mark A. Eckert[1], Judy R. Dubno[1]; [1]Medical University of South Carolina — Auditory processing depends on the integration of information across auditory and attention-related networks. The quality of auditory representations diminishes with age, which can increase the demands on diminishing attention-related networks that support stimulus perception and decision making. We examined the extent to which 1) stimulus-driven and task-driven neural activity predict auditory temporal processing, and 2) neural activity is altered with age-related changes in the structure of auditory and attention-related networks. We measured gap detection, EEG during active and passive listening, and regional gray matter volume in younger and older adults with normal hearing. Age-related differences in auditory temporal processing were greatest during challenging listening conditions, with older and younger adults exhibiting robust differences in stimulus-driven and task-driven neural activity. Power and phase synchronicity varied less as a function of active versus passive task conditions in older compared to younger adults and early theta power during passive listening was predictive of gap detection. Furthermore, ventral lateral prefrontal cortex and auditory cortex estimates of gray matter volume exhibited age-group differences and were predictive of EEG measures of attention modulation in older adults. Age-related differences in oscillatory activity and regional gray matter volume suggest a possible change in how information is gated between attention and auditory-related regions, which may be dependent on age-related changes in the structure of auditory and attention networks. Taken together, these results suggest an age-related decline in top-down modulation and an increased reliance on coherent bottom-up or stimulus-driven neural representations. [Work supported by NIH/NIDCD]

B8

TESTING THE AUDITORY SCAFFOLDING HYPOTHESIS: THE ROLE OF EARLY LANGUAGE IN ATTENTIONAL DEVELOPMENT Matthew Dye[1], Peter C. Hauser[2]; [1]University of Illinois at Urbana-Champaign, [2]Rochester Institute of Technology — The Auditory Scaffolding Hypothesis (Conway et al., 2009) is one variant of hypotheses that attribute deficits in visual functions to

auditory deprivation in deaf children. However, studies that support these "deficit hypotheses" have typically tested deaf children who were not exposed to a natural language from birth (ex. Horn et al., 2005; Yucel and Derim, 2008). The possibility remains, therefore, that any deficits observed in these deaf children may be attributable to delayed language acquisition and impoverished communicative environments in infancy. One commonly used measure of visual functions that has been used to demonstrate apparent visual deficits is the continuous performance test. This is a class of tests that all present long sequences of stimuli containing rare target events. The inability of deaf children to respond correctly to these rare events, and withhold responses to non-target events, has been used to suggest they have difficulties sustaining attention to sequences and in inhibiting inappropriate responses. In the study reported here, a continuous performance test (the Gordon Diagnostic System) was administered to hearing children aged 6-13 years and to deaf children who acquired American Sign Language as a native language from deaf parents, displaying typical natural language acquisition. The data suggest that a significant proportion of the deficits reported in the literature are attributable to delayed language acquisition during infancy, and not to auditory deprivation per se. Implications for educational practice and the impact on learning in deaf children are discussed.

EMOTION & SOCIAL: Development & aging

B9

RELATIONSHIPS AMONG WHITE MATTER HEALTH, DEPRESSION, AND COGNITION: A DIFFUSIONS TENSOR IMAGING STUDY. Kelly Rowe[1,2], Vincent Magnotta[1,2], Joy Matsui[1,2], Kelsey Vitense[1], Eric Axelson[1], Michael Brumm[1], Stephan Arndt[1,2], Sergio Paradiso[1,2], Peg Nopoulos[1,2], David Moser[1,2]; [1]University of Iowa Carver College of Medicine, [2]The University of Iowa — Diffusion tensor imaging is a sensitive modality with which to study white matter integrity. This technique was employed to study the effects of atherosclerotic vascular disease (AVD) on white matter, and to examine the relationship between white matter health and measures of depression, attention, and processing speed. Participants were 35 community-dwelling, stroke-free elderly AVD and 22 elderly healthy control (HC) participants. Fractional Anisotropy (FA), was calculated for whole-brain white matter and Talairach-defined sub-regions. Standardized psychological instruments assessed processing speed, attention, and depressive symptoms. T-tests and ANCOVA analyses were used to test the effects of group, age, gender, and interactions. Partial correlations were calculated between FA measures and scores from the psychological instruments. The relationship of FA in the subgenual cingulate with depressive symptoms was also analyzed. Compared to HC participants, AVD participants showed significantly lower FA values globally and in 3 sub-regions. ANCOVA analysis revealed significant effects of group, age, and sex. Significant correlations were found between FA values and depression and attention measures when analyzed across the whole group of participants (AVD + HC). An additional significant relationship between depressive symptoms and white matter health in the subgenual cingulate was identified in the right hemisphere of AVD participants, which was not significant in the left hemisphere or in the HC participants. The current findings suggest that white matter integrity shares an important relationship with cognition and mood functioning, even among individuals who are generally cognitively intact and whose level of depressive symptoms fall within broad normal limits.

B10

THE EFFECT OF DIVIDED ATTENTION AND AGING ON RECOGNITION OF POSITIVE FACES IN OLDER AND YOUNGER ADULTS Natalie Berger[1], Elizabeth A. Kensinger[2], Katja Werheid[3]; [1]Free University of Berlin, [2]Humboldt University of Berlin, [3]Boston College — Recent research has revealed a positivity-induced recognition bias for faces in elder adults. However, it is yet unclear whether this bias reflects a prioritization of positive information in the elderly, or a method to compensate for memory deficits. In this study we investigated biased recognition in healthy old and young adults using a divided attention paradigm. Younger and older adults studied happy, neutral, and angry faces, which in a subsequent recognition memory task were intermixed with 50% distractors. Half of the items were presented under full attention conditions; the other half were presented under divided attention conditions, along with an auditory decision task. In the full attention condition, older adults showed an enhanced recognition bias for happy faces compared to the young. In the divided attention condition, memory performance was diminished, and there were no longer age differences in recognition bias: older participants' enhanced bias for happy faces persisted, but young adults' recognition bias for happy faces was enhanced to the same level as in older adults. Our results support the view that the positivity-induced recognition bias is not related to aging itself, but to conditions in which cognitive resources are restricted, whether by age or by higher task demands.

B11

SUBREGIONS OF THE THALAMUS CONNECTED WITH FRONTAL AND TEMPORAL CORTEX SHOW GREATER AGE-RELATED DEGENERATION THAN OTHER SUBREGIONS David Clewett[1], Hanna Damasio[1], Mara Mather[1]; [1]University of Southern California — As a central relay station to cortex, the thalamus plays a critical role in the facilitation of sensory, motor, memory and executive processes. Distinct patterns of thalamocortical connectivity reflect the functionality of separate thalamic nuclei and relates to normal brain function. While previous studies have focused on disorders associated with thalamic pathology, little is known about how normal aging may affect specific sub-regions of the thalamus and their connections to cortical brain regions. To address this issue, we used diffusion tensor imaging (DTI) to examine thalamocortical connectivity in vivo in three age groups ranging from younger adults to older adults. Probabilistic tractography was used to trace connectivity between the left and right thalami and six cortical target regions. Putative nuclei were delineated for individual subjects via connectivity-based segmentation of the thalamus, such that subdivisions were determined by the cortical target with the highest probability of connectivity. Fractional Anisotropy (FA) and Mean Diffusivity (MD) values were extracted from the derived nuclei to localize and quantify age-related changes in microstructural integrity. Global decline in thalamic size and cortical connectivity was observed in older adults. Statistically significant degeneration with age was found in sub-regions predominantly connected to the frontal and temporal lobes, while sensory and motor regions were relatively spared. Changes in the spatial distribution of thalamo-temporal connections also suggests age-related decline in the mediodorsal nucleus of the thalamus, an area implicated in emotion and working memory. We conclude that differential thalamic degeneration may contribute to cognitive decline associated with normal aging.

B12

STRUCTURE AND FUNCTION OF THE HIPPOCAMPUS AND AMYGDALA VARY WITH AGE AND NEGATIVITY Zachary Ingbretsen[1], Kristin Flanary[1], Robert S. Chavez[1], Catherine J. Norris[1]; [1]Dartmouth College — Clinical levels of chronic and traumatic stress have been implicated in atrophy and functional impairments of the hippocampus and amygdala. In the current study, we examined the relationships between age (18-25 vs. 60-85 year olds), individual differences in negativity, and the structure and function of the hippocampus and amygdala in a healthy population using functional magnetic resonance imaging (fMRI) and voxel-based morphometry (VBM) to see if stress-related personality traits have similar effects to clinical levels of stress on these structures. We predicted that individuals high in negativity may exhibit structural and functional impairments of the hippocampus and amygdala, and that such impairments would increase with age. Negativity was defined using a factor analysis to combine across individual difference measures of depression, neuroticism, negative affect, trait anxiety and loneliness, which loaded on one dimension. A VBM analysis showed that negativity correlated with decreased gray matter density in the anterior heads of the bilateral hippocampi. Importantly, this association was stronger in older individ-

uals, consistent with our hypothesis that effects of personality traits on the structure and function of brain structures regions increase over the life-course. Furthermore, more negative older individuals tended to exhibit greater activation in of the hippocampus and amygdala in response to unpleasant stimuli, and they rated such stimuli as more arousing than both less negative and younger individuals. Our results provide evidence that highly negative but otherwise healthy individuals may experience structural and functional changes in the hippocampus and amygdala that could have implications for emotional memory and reactivity.

B13

AGE AND SEX EFFECTS ON COGNITIVE AND EMOTIONAL EMPATHY Janelle Beadle[1], Natalie Denburg[1], Jessica Caballero[2], Sergio Paradiso[1]; [1]University of Iowa, [2]University of Puerto Rico Mayaguez — INTRODUCTION. Older adults report lower cognitive empathy than younger adults. In youth, women report higher empathy because they may be motivated to be seen as nurturing. However, sex is typically not considered in aging studies of empathy. In late life, both men and women demonstrate a newfound prioritization of close relationships and may prefer to be viewed as empathetic. This study examined sex and age effects on cognitive and emotional empathy. It was predicted that men would show higher empathy with older age, whereas women would show stable empathy. METHOD. Emotional empathy (Interpersonal Reactivity Index Empathic Concern subscale; score range: 0-28) and cognitive empathy were measured (Empathy Quotient Cognitive Empathy factor; score range: 0-18). RESULTS. The model predicted females to score 5.3 points higher than men in emotional empathy with age predicting a .1 point increase each year [model: R^2=.13; $F(3,248)$=12.6; $p<.001$; Sex B=5.3; Age B=.1; sex x age B= -.05]. On the other hand, for cognitive empathy age was predicted to decrease empathy .1 points each year, while sex was found to be not significant [model: R^2=.07; $F(3,153)$=4.1, $p<.001$; sex: B= -2; age: B= -.1; sex x age: B=.05]. DISCUSSION. Women reported higher emotional empathy across the lifespan. Corroborating aging studies, cognitive empathy was lower with older age. In contrast, emotional empathy showed age-related increases. Among women, motivation to be perceived as empathetic may influence emotional empathy to a greater extent than cognitive empathy. Future studies should consider effects of sex and age on motivation to report high empathy.

B14

DEVELOPMENT OF FEAR EXTINCTION LEARNING AND SPONTANEOUS RECOVERY IN MICE AND HUMANS Stephanie Duhoux[1], Siobhan Pattwell[1], Alisa Powers[1], Natasha Mehta[1], Erika Ruberry[1], Theresa Teslovich[2], B.J. Casey[1,2], Francis S. Lee[1,2]; [1]Weill Cornell Medical College, [2]Weill Cornell Graduate School of Medical Sciences — Despite a high prevalence of anxiety disorders in children and adolescents, there is little evidence for when, during development, an intervention or treatment will be most, or least, effective. One of the most commonly used therapies, exposure therapy, relies on principles of fear extinction learning. We utilized parallel paradigms, in mice and humans, to identify differences in the persistence and attenuation of fear memories across development. Conditioned fear memories were acquired via tone-shock pairings and colored square-aversive sound pairings, in mice and humans, respectively. Extinction of fear memories was then examined across several days. Dependent measures were percent freezing, in mice, and peak amplitude of galvanic skin response, in humans. We found age-specific differences in extinction learning and spontaneous recovery of conditioned fear memory. In particular, pre-adolescent and adult mice and humans showed significant extinction learning, whereas adolescent mice and humans showed little evidence of fear extinction learning. In addition, pre-adolescent mice did not show spontaneous recovery, supporting the idea of a fragile memory trace that is susceptible to erasure, whereas adolescent mice did show spontaneous recovery, suggesting an intact memory trace. The spontaneous recovery findings tended to be replicated in humans, but were less robust in part due to attrition with multiple days of testing. The mouse and human findings suggest a potential temporal window during adolescence when exposure therapy, may be less effective. These findings suggest that development of fear regulation through adolescence is not linear and that therapeutic interventions should be designed based on these temporal windows.

B15

NEURAL MECHANISMS UNDERLYING SUCCESSFUL EMOTION REGULATION: A COMPARISON OF TWO STRATEGIES USING DYNAMIC VIDEO STIMULI Eric Allard[1], Elizabeth Kensinger[1]; [1]Boston College — Several studies have contributed to our knowledge of the neural mechanisms underlying emotion regulation. However, a large proportion of studies examining neural links to successful emotion regulation have been limited in the strategies assessed and stimuli employed. The goal of the current study was to examine neural recruitment during two voluntary emotion regulation tasks using dynamic, emotionally evocative video stimuli. Twenty subjects (aged 18-35) viewed a series of positive, negative, and neutral film clips during an event-related fMRI scan session. Participants viewed the videos in three blocks with a separate set of instructions for each block: passive viewing, guided selective attention (engage with positive and avoid negative-evoking portions of the film), and cognitive reappraisal. In the cognitive reappraisal task, participants were instructed to downregulate their response to the negative videos while maximizing their pleasant feelings toward the positive videos. Results revealed diminished activation in a region of the left amygdala when regulating responses to negative videos as compared to passively viewing negative videos. In examining valence differences within the regulation conditions, activation was greater within a region of MPFC when selectively attending away from negative film clips as compared to engaging with positive film clips. Furthermore, when reappraising negative videos, activation with a region of ACC was greater than when amplifying reactions to positive videos. This pattern of findings is in line with previous studies of emotion regulation demonstrating diminished amygdala activation and increased medial prefrontal engagement during voluntary regulation of negative emotional inputs.

B17

OLDER ADULTS' POSITIVITY EFFECT IN MEMORY IS RELATED TO THEIR AMYGDALA-MPFC FUNCTIONAL CONNECTIVITY DURING REST Michiko Sakaki[1], Lin Nga[1], Mara Mather[1]; [1]University of Southern California — Older adults tend to remember and pay attention to more positive and less negative information than do younger adults (Mather & Carstensen, 2005). This positivity effect was revealed to be associated with increased couplings between amygdala and medial prefrontal cortex (MPFC) when processing negative information (St Jacques et al., 2010). However, little is known about whether the positivity effect in older adults modulates functional connectivity even during baseline states. Using functional magnetic resonance imaging, we examined amygdala functional connectivity during rest from 20 older and 20 younger adults (age range 61-78, 19-37 respectively). To address the similarity in brain activity between during baseline and emotional processing, all participants underwent a learning phase after the resting scan, where they viewed videos depicting angry and neutral faces. Finally, their memory about emotional and neutral faces was tested. Consistent with previous results, older adults' positivity effect in emotional face memory was associated with greater activity in MPFC during learning angry than neutral faces. Moreover, older adults' positivity effect for the emotional faces was related with stronger functional connectivity between amygdala and MPFC during rest. In older adults but not in younger adults, the amygdala-MPFC connectivity during rest predicted the enhanced MPFC activity when learning angry faces compared with neutral faces. These results suggest that chronic emotion regulation goals in older adults increase amygdala-MPFC coupling even during resting states, which may help support greater MPFC recruitment when emotion regulation is needed to inhibit responses to negative stimuli.

B18

KIDS, CANDY AND THE BRAIN: NEURAL RESPONSE TO CANDY REWARDS AND PUNISHMENTS OVER DEVELOPMENT Katherine Luking[1], Deanna Barch[1]; [1]Washington University in Saint Louis — How we react to rewarding and punishing stimuli in our environment is a critical component of a host of cognitive processes including attention, motivation, learning, and risk taking. Converging evidence from animal models and human studies has clarified the neural systems underlying reward processing in adults. However, fewer studies have investigated developmental changes within these systems using groups defined by both age and pubertal development. We utilized fMRI and a modified version of a card guessing game where candy pieces delivered post-scan served as the reinforcer. Healthy pre-pubertal children 7-10 years old and young adults 22-26 years old won and lost large and small amounts of candy based on their ability to guess whether the number on a mystery card was above or below 5. BOLD activity following the candy gain (large/small), loss (large/small) and neutral feedback (no gain/loss) was compared between developmental groups. During gains, both children and adults recruited regions such as the caudate, putamen, midbrain and insula, typically involved in reward response. Interestingly, however, the adults display a much stronger response to reward in the insula and orbital frontal cortex. During losses, both children and adults displayed greater activation in the insula and midbrain to punishment than neutral, but less activation in regions such as the hippocampus/amygdala. Thus, although there are clear similarities in the regions recruited by children and adults during both candy gain and loss, there are also significant differences in level of activity in regions such as the insula and orbital frontal cortex.

B19

MINDFULNESS DISPOSITION AND DEFAULT-MODE NETWORK CONNECTIVITY Ruchika Prakash[1], Maryanna Klatt[1], Angeline DeLeon[1], William Malarkey[1]; [1]The Ohio State University — An extensive body of research defines the default-mode network to be one of the critical networks of the human brain, demonstrating coherence throughout our lifespan, and playing a pivotal functional role in regulating affective and cognitive control. Alterations in the connectivity of this network as a function of aging have been found, with reductions associated with functional ramifications for the elderly population. This study examined associations between age-related reductions in the integrity of the DMN and trait levels of mindfulness disposition, defined by our ability to experience the present moment in its entirety, without dwelling on the past or worrying about the future. Twenty-five older and twenty younger adults participated in the study and underwent a brief functional MRI session and filled out questionnaires related to their overall health, and mindfulness disposition. Consistent with previous research, we found an age-related reduction in the coherence of the default-mode network in the precuneus, posterior cingulate cortex, and the left parahippocampal gyrus. Mindfulness disposition, in turn, was associated with an increased coherence between regions of the DMN, such that higher levels of mindfulness disposition in the elderly were associated with increased spontaneous oscillations between the precuneus and the posterior cingulate cortex. Mindfulness disposition thus explains some variance in the connectivity of one of the more intrinsic networks of the human brain, known to be critical for promoting self-relevant mental explorations and building cognitive reserve to engage in exogenous processing.

B20

PUBERTY EFFECTS ON SUBCORTICAL BRAIN VOLUMES DURING ADOLESCENCE: A LONGITUDINAL STUDY Snezana Urosevic[1], Ryan Muetzel[1], Paul Collins[1], Kelvin Lim[1], Monica Luciana[1]; [1]University of Minnesota--Twin Cities — Puberty is an essential developmental process of adolescence and increasingly linked to the maturation of emotional processing functions that extend beyond sexual contexts. There is also preliminary evidence for a link between puberty and structural changes in subcortical brain regions involved in emotional processing and those with sexual dimorphic patterns (e.g., Bramen et al., 2011). However, there is no data examining unique effects of puberty (controlling for age) on longitudinal changes in subcortical brain volumes. The present study examined these unique effects of puberty and interaction effects of puberty and sex on concurrent subcortical volumes and prospective changes in these volumes. The sample of 106 healthy adolescents, ages 9 to 18, was assessed for pubertal status using picture depictions of Tanner stages (Taylor et al., 2001). To assess brain volumes at baseline and at a two-year follow-up, MRI images were acquired using a 3-T Siemens Trio scanner (TR = 2530 msec, TE = 3.65 msec, TI = 1100 msec, 240 slices, voxel size =1.0mm x 1.0mm x 1.0mm, flip angle = 7°, FOV = 256 mm) and processed using FreeSurfer software to quantify subcortical volumes (e.g., amygdala, caudate, hippocampus, nucleus accumbens, pallidum, putamen) within each hemisphere. Results suggest unique effects of puberty on subcortical volumes involved in emotional processing, such as nucleus accumbens, and puberty by sex interaction effects on some subcortical volumes, such as caudate. Thus, the study implicates puberty as potentially driving structural brain changes that may underlie increased reward sensitivity and emerging sex differences during adolescence.

B21

UNLIKE ADULTS, INFANTS' VISUAL PREFERENCES ARE DRIVEN BY LOWER-LEVEL VISUAL FEATURES Edward Vessel[1], Lauren Burakowski[2], Lauren Krogh[2], Scott Johnson[2]; [1]New York University, [2]University of California, Los Angeles — What information guides infants' visual preferences? Adult spontaneous visual preferences are largely determined by semantic associations - when asked to indicate preferences for real-world scenes containing shared semantic associations, adults show high agreement in which images are preferred (Vessel & Rubin, 2010). However, when the same adults indicate preferences for abstract images (e.g. fractals) containing no common semantic interpretations, preferences are highly individual. Therefore, adults' shared semantics lead to shared preferences. Infants, however, are unlikely to have developed semantic associations. What drives their preferences, and will they show agreement? We measured preferences for fourteen 5-month-old infants. During each session, infants viewed a set of real-world or abstract images. Pairs of images were presented side-by-side (4sec) and preference was measured by which image the infant fixated longer. Preference scores computed from the paired-comparison data were compared across infants. Surprisingly, agreement in preference across infants was high for both real-world and abstract images (0.45 for scenes: $t(44) = 18.4$, $p < 0.0001$; 0.46 for abstract images: $t(44) = 16.1$, $p < 0.0001$). These means are not different ($t(44) = 0.32$, $p = 0.75$), indicating that infants have similar agreement for both types of images. These data suggest that infants' visual preferences are driven by lower-level visual features (e.g. shape and color), which are present in both abstract and real-world images. The highly individual preferences for abstract images in adults strongly suggests a developmental change in the information used to compute preferences. As children acquire knowledge of semantic associations, these associations come to dominate preference.

EXECUTIVE PROCESSES: Development & aging

B22

A FUNCTIONAL MRI INVESTIGATION OF THE ASSOCIATION BETWEEN CHILDHOOD AEROBIC FITNESS AND NEUROCOGNITIVE CONTROL Laura Chaddock[1], Kirk Erickson[2], Ruchika Prakash[3], Michelle Voss[1], Matt VanPatter[1], Matthew Pontifex[1], Charles Hillman[1], Arthur Kramer[1]; [1]University of Illinois, [2]University of Pittsburgh, [3]The Ohio State University — Aerobically fit children have been found to exhibit superior cognitive control relative to lower-fit children, and performance differences are related to brain volumes and ERP indices. This study used fMRI to examine brain activity of higher-fit (N=14) and lower-fit (N=18) 9- and 10-year-old children during a flanker task. The flanker task requires a response to the direc-

tion of a central target amid distractors, and incongruent trials (e.g., >><>>) are said to require increased cognitive control relative to congruent trials (e.g., >>>>>). We examined fMRI activation and performance during early and late task blocks of the flanker paradigm as a function of aerobic fitness and task difficulty. For congruent trials, all children showed increased recruitment of frontal and parietal regions during the early block when the task was unfamiliar, followed by a decrease in activity in the later block as the task became more familiar. No within-group changes in congruent accuracy were reported across task blocks, despite a decline in performance across all participants, likely due to fatigue. During incongruent trials, only higher-fit children maintained accuracy across blocks, coupled with increased prefrontal and parietal recruitment in the early task block and reduced activity in the later block. Lower-fit children showed a decline in incongruent accuracy across blocks, and no changes in activation. We suggest that higher-fit children are better at adapting neural processes involved in cognitive control to maintain task goals. Because children are becoming increasingly unfit, understanding the neurocognitive benefits of an active lifestyle has important public health implications.

B23

DEVELOPMENT OF INDIVIDUAL ACTIVATION DURING PERFORMANCE MONITORING IN MEDIAL FRONTAL CORTEX: A HIERARCHICAL LINEAR MODEL OF TOPOGRAPHIC PATTERNS Suzanne Perkins[1], Robert Welsh[1], Emily Stern[2], Stephan Taylor[1], Kate Fitzgerald[1]; [1]University of Michigan, [2]Mount Sinai School of Medicine — Age-related improvements in performance monitoring have been linked to the maturation of medial frontal cortex in healthy youth. Previous studies do not control for number of peak activations, size of clusters, age and accuracy on the task. A three-level hierarchical linear model (HLM) was fitted to examine locations of peaks and both between subject and within brain characteristics. We used two different outcome measures of location of activation, radius from the corpus callosum and longitudinal spline (LS) (distance along the corpus callosum, Stern, Welsh, Fitzgerald, & S. F. Taylor, 2009). In the final interference model, age (? = -0.80, t = -6.69, p < 0.001) and percent accuracy (? = -29.97, t = -2.77, p = 0.012) were predictors of LS when controlling for differences in cluster extent, such that for each year older peak location was .8 mm more dorsal and posterior along the corpus callosum and with 1% greater accuracy activation was ~3 mm more dorsal and posterior. In the final error model, age was not a factor, however, there was a difference in LS based on total number of errors (? = -0.29, t = -2.19, p < 0.05), such that with fewer errors, activations were more rostral and anterior. The results suggest that with greater maturity improved performance interference processing becomes more dorsal and posterior whereas during the processing of errors the greater number of error committed the more rostral and anterior processing takes place, separate from development.

B24

THE EFFECTS OF BRAIN TRAINING GAMES ON COGNITIVE PERFORMANCE, SELF-EFFICACY, AND MOOD Janna K. Comrie[1], Ashley F. Curtis[1], Laura Branscombe-Caird[1], Paula M. McLaughlin[1], Susan J.E. Murtha[1]; [1]York University — OBJECTIVE: The present study investigated whether computerized brain training programs can influence cognitive functioning and mood in middle-aged adults. METHODS: Fourteen participants (ages 46-55 years) engaged in an experimental Brain Training condition that required them to play "Big Brain Academy" on a Nintendo DS for one hour, three times a week, for six weeks. To emulate the time working with technology, during the control Trivia Questions condition, participants spent the same amount of time using an online search engine finding answers to trivia questions. Half the participants completed the Brain Training condition first followed by the Trivia Questions condition. The remaining participants did the conditions in the reverse order. A comprehensive neuropsychological battery was used to measure the influence of brain training on cognitive functioning. RESULTS: Brain Training significantly increased verbal fluency (p = .003) and significantly decreased self-reported anxiety (as measured by both the Profile of Mood States & the Hospital Anxiety and Depression Scale) as compared to the Trivia Questions condition. The decrease in anxiety was sustained over an additional 6-week follow-up period. CONCLUSIONS: Brain Training provided limited improvement on standardized measures of cognitive functioning. Upon completing the Brain Training program, participants demonstrated a significant reduction in anxiety and an increase in cognitive fluency. It is possible that reduced anxiety resulted in improved verbal fluency, but more research is needed to define this relationship. Future research should investigate the neural mechanisms of this effect and the longer-term cognitive training benefits on different measures of anxiety and executive functions.

B25

AGE DIFFERENCES IN INCENTIVE PROCESSING: BEYOND THE REWARD NETWORK Julia Spaniol[1], Holly J. Bowen[1], Pete Wegier[1], Cheryl L. Grady[2,3]; [1]Ryerson University, [2]Rotman Research Institute at Baycrest, [3]University of Toronto — Reward anticipation is associated with activity in the dopaminergic midbrain as well as the ventral striatum, amygdala, and medial prefrontal cortex. Dopaminergic neuromodulation declines with age, suggesting that incentive processing should also undergo age-related change. However, the literature is mixed, perhaps reflecting variation in the degree to which tasks made demands on learning and memory. Furthermore, the emphasis has been on the reward network, with few studies addressing reward-related activations in other brain regions. In the current study, 16 younger adults (mean age: 25.4) and 15 older adults (mean age: 69.0) underwent fMRI while completing a variant of the monetary incentive delay task (Knutson et al., 2001; Samanez-Larkin et al., 2007). This task allowed the separate assessment of responses to gain and loss incentive cues, while minimizing demands on learning and memory. We assessed incentive-related activations using mean-centered Partial Least Squares (PLS; McIntosh et al., 2004), a data-driven multivariate technique optimal for identifying spatio-temporal whole-brain activation patterns associated with variation in task conditions. The analyses yielded two significant latent variables representing distinct incentive-related activation patterns. The first pattern showed robust activation of the reward network and was not modulated by age. The second pattern, peaking ~10s after cue onset, showed increased activation in older adults of a network of fronto-parietal regions. Neither pattern was modulated by incentive valence. Overall, these findings suggest that aging may not affect primary motivational processing in the reward network, but may be associated with incentive-driven up-regulation of cognitive control in the service of action preparation.

B26

COGNITIVE TRAINING IN HEALTHY OLD AGE: COMPARISON OF 3 TRAINING TASKS ON COGNITIVE FUNCTIONING AND WHITE MATTER INTERGRITY. Pamela Greenwood[1], Ellen Clarke[1], Maren Strenziok[1], James Bicksel[2], Ryan McGarry[1], Jon Strohl[1], James Thompson[1], Raja Parasuraman[1]; [1]George Mason University, [2]Memory Center of Fairfax Inova Hospital — Cognitive training has the potential to slow or delay cognitive decline in healthy aging. Neural plasticity may play a role in far transfer, with training-related changes observed in white matter integrity (e.g. Takeuchi et al., 2010). To understand what aspects of training are important for improving cognition and brain function in old age, we assessed 3 training tasks on training transfer, cortical thickness, and white matter integrity. Healthy, screened older adults (aged 60-80) were assessed for baseline brain structure (sMRI scan with MPRAGE, DTI, resting connectivity) and cognitive function (neuropsychological tests, working memory (WM) and attention tasks, objective assessments of everyday problem solving). Participants were randomly assigned to one of three cognitive training tasks: Posit's Brain Fitness (BF) focused on auditory cognition, Microsoft's Rise of Nations (RoN) - a broad-based strategy game, and Space Fortress (SF) which is a complex task involving both cognitive and motor components. Training sessions were supervised weekly in the laboratory with feedback and instruction. Participants

played an hour a day, 6 days a week, for 6 weeks and performance at home was monitored. Following training, a post-training sMRI and cognitive battery were administered. Benefits of training were strongest for SF on everyday problem solving and WM. Effects of SF and BF but not RoN were seen on WM. Fractional anisotrophy showed training-related change following SF and BF in white matter in left prefrontal and parietal cortices and temporal lobe. Thus, tasks which loaded discrimination and motor skills showed stronger cognitive and brain effects.

B27

OBESITY, FITNESS, AND COGNITION IN CHILDREN Cynthia Krafft[1], Benjamin Austin[2], Qingyang Li[3], Abby Weinberger[1], Kara Dyckman[1], Patricia Miller[4], Phillip Tomporowski[1], Jennifer McDowell[1], Catherine Davis[5]; [1]University of Georgia, [2]University of Wisconsin, [3]Child Mind Institute, [4]San Francisco State University, [5]Georgia Health Sciences University — Previous studies have demonstrated that there are relationships between obesity, fitness, and measures of cognitive control. In adults, increased obesity and decreased fitness have been associated with better executive control (EC). In children, increased obesity and decreased fitness have been associated with lower performance on tests of aptitude, achievement, and EC. The current study further investigated how fatness and fitness are related to EC by examining performance on behavioral measures of EC. Participants were 125 sedentary, overweight (BMI greater than or equal to the 85th percentile) children 8 - 11 years old. All participants underwent standard tests measuring fatness and fitness. The antisaccade task was used as a behavioral measure of EC. Correct antisaccades require the inhibition of a reflexive glance towards a visual cue presented in the periphery, and the generation of a volitional saccade towards its mirror image (opposite side, same distance from center). An initial glance towards the cue is an antisaccade error and is construed as a failure of EC. Exploratory analyses in this group of overweight children indicate that performance on antisaccades was associated with measures of fatness and fitness, as well as performance on other cognitive measures. Generally, better antisaccade performance was associated with lower fatness and higher fitness measures. Specifically, increased treadmill time was associated with an increased percent of errors corrected when controlling for race and gender. In sum, this study extends the documented relationship between obesity, fitness, and EC into an overweight sample of children engaged in behavioral measures of EC.

B28

FUNCTIONAL ACTIVATION MEDIATES THE AGING EFFECT ON REACTION TIME IN A TASK-SWITCHING PARADIGM. Yunglin Gazes[1], Christian Habeck[1], Jason Steffener[1], Brian Rakitin[1], Yaakov Stern[1]; [1]Columbia University — The goal of this study was to determine the age-related neuronal changes (via fMRI) that predict age-related performance changes in single-task and task-switching conditions for elder (n = 23, M = 65.2 ± 2.65) and young (n = 24, M = 25.2 ± 2.73) participants. The activation task was a task-switching paradigm consisting of vowel/consonant and upper/lower-case identification using the color of the stimulus as task cue. Ordinal trend covariance analysis, a multivariate analysis, was used to isolate a task-related fMRI activation network. This analytical approach specifically identifies the set of brain regions that increases in activation with increasing task demand. Expression of the task-related network was then tested as a mediator of age and reaction time (RT) in a mediation analysis. A task-related network was identified in which regions that increased in activation with task level included extensive bilateral insula extending into superior temporal cortex, bilateral anterior cingulate, right supplementary motor area, and left inferior frontal cortex. Expression of this pattern was found to be a significant mediator of the aging effect on RT in both task conditions such that expression of the task-related network correlated negatively with both age and RT, suggesting that younger subjects express this pattern more than elder adults and that expression of the pattern is associated with better performance. Our result showed that the age-associated change in performance is partially explained by reduced expression of a task-related network, thus providing evidence for the link between age-related behavioral changes and altered brain activation.

B29

SCAFFOLDING ACROSS THE LIFESPAN IN CHOICE-DEPENDENT, DYNAMIC DECISION MAKING Jessica A. Cooper[1], Darrell A. Worthy[2], W. Todd Maddox[1]; [1]University of Texas at Austin, [2]Texas A&M University — The scaffolding hypothesis of cognitive aging suggests that older adults recruit a broader range of frontal regions, relative to younger adults, to compensate for age-related neural declines in a variety of cognitive tasks (Park & Reuter-Lorentz, 2009). Recent work from our lab (Worthy, et al, 2011) found an age-related performance advantage in choice-dependent decision making that we attributed to a shift in reliance from a striatally mediated model-free system to a frontally mediated model-based system (Glascher et al., 2010). Scaffolding is also predicted to occur across the lifespan when more neural resources must be recruited due to increased task demands. Older adults may face a "crunch" point when task demands exceed the neural resources that can be recruited, resulting in poor performance (Reuter-Lorenz & Cappell, 2008). However, younger adults may perform better with increased task demands due to a shift toward model-based decision making. To test this hypothesis we had older and younger adults perform either a two-choice dynamic decision-making task under either pressure or no pressure, or a four-choice task under no pressure. We found strong support for our predictions. Older adults performed better on the two-choice task while under no pressure, while younger adults performed better under pressure on the two-choice task and better on the four-choice task. Thus the older brain under no pressure and with low task complexity operates similarly to the younger brain under pressure and with increased task complexity. We interpret these results as evidence of compensatory scaffolding across the lifespan.

B30

AGE DIFFERENCES IN PREFRONTAL ACTIVATION ENHANCE SELECTION OF FUTURE REWARDS Marissa Gorlick[1], Darrell Worthy[2], Akram Bakkour[1], Jeanette Mumford[1], Russell Poldrack[1], Todd Maddox[1]; [1]University of Texas at Austin, [2]Texas A&M University — Park and Reuter-Lorentz' (2009) scaffolding hypothesis of cognitive aging suggests that older adults recruit a broader range of prefrontal regions relative to younger adults to compensate for age-related neural declines. We (Worthy, Gorlick et al, 2011) recently found an age-related performance advantage in two-option choice-dependent decision-making. In this task, one option always yields a larger immediate reward, but causes rewards for both options to decrease, whereas the other option always yields smaller immediate reward, but causes future rewards to increase. The optimal strategy is to forgo the immediately rewarding option and to select the option that increases future rewards. We attribute the age-related advantage to older adults' ability to switch from a striatally mediated model-free system, which seeks options with better immediate rewards, to a frontally mediated model-based system, which develops a global mental model of the reward structure (Glascher et al., 2010). In the current research, younger and older adults completed the Worthy et al decision making task in an fMRI scanner. In line with the scaffolding hypothesis, we predicted that older adults would recruit a broader range of prefrontal areas, and may show weaker activation in the striatum. We replicated the age-related performance advantage. Our fMRI results support the hypothesis that older adults are using increased prefrontal activation to guide selection of future rewards. Older adults have greater orbitofrontal and frontal pole activation than younger adults. On the other hand, older adults have weaker bilateral caudate and right putamen activation than younger adults.

B31

AGE-RELATED DIFFERENCES IN NEURAL ACTIVATION: THE ROLE OF DEFAULT MODE NETWORK CONNECTIVITY Angeline De Leon[1], Beth Patterson[1], Ruchika Shaurya Prakash[1]; [1]The Ohio State University — Aging is associated with prominent changes in the functional neuroarchitecture of the brain. A consistent finding within this domain of study is a general

pattern of task-related cortical overactivation in older adults. To date, however, the operational significance of this increased neural activity remains unclear. Recent investigations of the resting-state brain have implicated the Default-Mode Network (DMN), distinguished by its consistent patterns of activation and fluctuation during rest periods and its extensive connectivity with other higher-order brain networks, in the critical modulation of cortical activity. Given additional evidence for the age-related deterioration of DMN functionality (i.e., reduced activation as well as functional connectivity), the present study investigated age-related differences in task-related cortical recruitment as a function of DMN integrity. 18 young and 20 older adults were recruited to complete the Flanker Task and a resting-state scan inside an MRI scanner. For Flanker data, a direct comparison of young and older subjects confirmed overall enhanced cortical recruitment of attentional areas for older adults, relative to young. In examining the influence of reduced DMN connectivity on cortical recruitment, a voxel-based linear regression revealed age-related differences in the functional significance of DMN disintegration. While DMN breakdown in older adults was associated with patterns of task-related cortical activation as well as regional over-activation, in young adults, it was specifically associated with activation of DMN-related areas. Overall, findings provide evidence for the importance of the DMN's intrinsic coherence in regards to neural functioning, highlighting in particular the implications of DMN disintegration for the aging brain.

LANGUAGE: Development & aging

B32

AGE, SEX, AND VERBAL ABILITIES AFFECT LOCATION OF LINGUISTIC CONNECTIVITY IN VENTRAL VISUAL PATHWAY Douglas D Burman[1], Taylor Minas[2], Donald J Bolger[3], James R Booth[2]; [1]NorthShore University HealthSystem, [2]Northwestern University, [3]Maryland University — Previous studies have shown that the strength of connectivity between regions can vary depending upon the cognitive demands of a task, implicating these connections in task performance. In this study, the location of task-dependent connectivity from the primary visual cortex (V1) is examined in 43 children (ages 9-15) performing visual tasks. Task-dependent connectivity maxima were identified for a visual task requiring a linguistic (spelling) judgment. Multiple regression analysis demonstrated significant effects of age, sex, and verbal IQ on maxima coordinates; analysis of variance identified interaction between these factors. Increases in age and verbal IQ produced similar shifts in maxima location; in girls, connectivity maxima shifted primarily laterally within the temporal lobe, whereas the shift was primarily posterior within occipital cortex among boys. A composite map across all subjects shows an expansion in the area of connectivity with age, extending posterior into extrastriate occipital cortex, lateral within fusiform gyrus and adjacent inferotemporal cortex, and anterior within inferotemporal cortex. Our findings indicate that developmental changes in connectivity are important for linguistic function, that girls and boys may use different strategies for performing linguistic tasks, and that individual variability in the location of connectivity can vary systematically.

B33

LEARNING TO READ REORGANIZES THE ORAL LANGUAGE NETWORK ONLY IN ALPHABETIC WRITING SYSTEMS Christine Brennan[1], Fan Cao[1,2], Nicole Pedroarena-Leal[1], Chris McNorgan[1], James R. Booth[1]; [1]Northwestern University, [2]Nanyang Technological University — We sought to investigate how the nature of different writing systems (i.e., English and Chinese) influences the development of the oral language network. We expected that orthography should influence the phonological network to a greater degree in English because of strong associations between the visual letter forms and the phonemes they represent, whereas Chinese has weaker associations between orthography and phonology. Whole-brain and region-of-interest analyses were utilized to compare English and Chinese children and adults who completed an auditory rhyming task during fMRI. Manipulation of spelling and rhyme information allowed us to measure the influence of conflicting and non-conflicting orthographic information in both languages. We found an interaction between language and age in the phonological network with the greatest developmental increases in English for conflicting compared to non-conflicting conditions, suggesting that reading influences the nature of the phonological system. Alphabetic systems foster development of strong phonological representations due to strong associations between visual letter forms and corresponding phonemes. A positive correlation between reading skill and activation of the auditory cortex was found only for English children, suggesting that alphabetic orthographies enhance phonological skills and lead to greater engagement of phonological regions during spoken word processing; this is not seen for Chinese because letter to sound mappings are not engaged. In conclusion, the current study reveals that writing system differences do seem to lead to cross-cultural brain divergence with alphabetic orthographies enhancing phonological awareness skills and restructuring the auditory cortex.

B34

PRIMARY AUDITORY CORTEX SHOWS AGE-RELATED INCREASES IN SENSITITIVITY TO MULTIMODAL CONGRUENCY Chris McNorgan[1], Neha Awati[1], James R. Booth[1]; [1]Northwestern University — Multimodal cognitive processes are ubiquitous, involving integration of information from multiple senses. Fluent whole word reading is dependent on a learned association between phonemes and an abstract orthography and is therefore one such process that requires integration of input from both auditory and visual processing areas. Studies that have more closely examined the multisensory nature of reading have attempted to identify and clarify the network and functionality of the brain regions involved in multisensory language processing. Previous research has shown the posterior region of the superior temporal sulcus to be sensitive to manipulations of congruency, in terms of temporal and letter-phoneme identity, between simultaneously presented letter and speech sounds, implicating this region as an audio-visual integration locus (van Atteveldt et al., 2009). Additionally, these studies have shown that crossmodal congruency modulates activity in primary auditory processing areas, namely the Heschl's Gyrus (HG), and planum temporale (PT). In the present study, we test whether analogous congruency effects appear at the whole word level, were dependent on lexicality, and develop with age. Eighteen typically developing children made phonological judgments to two sequentially presented words in one of three modality conditions. Results showed developmental increases for crossmodal versus unimodal congruency in both the HG and PT. These results suggest that increased reading skill in alphabetic languages is accompanied by an increasingly multimodal phonological store.

B35

NEURAL PROCESSING OF WORD STRESS AND PHONEMES IN 3- AND 6-MONTH-OLD INFANTS Angelika Becker[1], Ulrike Schild[1], Claudia K. Friedrich[1]; [1]University of Hamburg — Infants process the prosody of their maternal language different from other language prosodies quite after birth. However, within their first months of life they do not show different processing of phonemes of their maternal language compared to phonemes that are not used in their maternal language. Here we tested whether neural processing of word stress and phonemes undergoes fundamental changes between 3 and 6 months after birth. We presented stressed syllables and unstressed syllables (primes). Each prime was followed by an initially stressed disyllabic spoken German word (target). Half of the primes shared the initial phonemes with their targets (e.g. pup – Puppe [Engl. doll]). Half of the primes did not share the targets' phonemes (e.g. fe – Puppe). EEG – Data of 30 3-month-olds and 30 6-month-olds from German speaking environments were analyzed. In the 3-month-olds target words elicited different ERPs if they were preceded by stressed vs. unstressed primes. There was no ERP effect for phoneme overlap between prime and target in 3 month-olds. We observed the opposite pattern for 6-month-olds. Target words elicited different ERPs if they were preceded by primes with the same initial phonemes com-

pared to primes with different phonemes. There was no ERP effect for stress overlap between prime and target in 6 month-olds. Thus, it seems that stress-based language representations develop earlier and independent from phoneme-based language representations in infancy.

B36

LARGE-SCALE PHASE SYNCHRONY OF BRAIN ACTIVITY IN PREVERBAL INFANTS DETECTING SOUND SYMBOLISM Keiichi Kitajo[1,2,3], Michiko Asano[4,5,6], Guillaume Thierry[7], Sotaro Kita[8], Hiroyuki Okada[6], Mutsumi Imai[4]; [1]RIKEN BSI-Toyota collaboration center, [2]RIKEN Brain Science Institute, [3]JST PRESTO, [4]Keio University, [5]JSPS, [6]Tamagawa University, [7]Bangor University, [8]The University of Birmingham — Sound symbolism refers to a non-arbitrary relationship between linguistic sound and meaning. A previous study has suggested that sound symbolism helps 3-year-olds to identify the referents of a new word (Imai et al., 2008). An important question is whether infants are sensitive to "natural" sound-meaning correlates before they start word leaning, which may be mediated by biologically-driven, spontaneous auditory-visual integration. To answer this question, we conducted a "bouba-kiki" experiment (Ramachandran & Hubbard, 2001) with 11- to 12-month-olds (N=19) using EEG measures. The infants were presented with a spiky or rounded visual shape followed by a nonsense linguistic sound consisting of either voiceless stops and high vowels or nasal consonants and mid/low vowels ("kipi" and "moma", respectively). Shape and sound were sound-symbolically matched in half of the trials, and mismatched in the other half. We measured 9-channel scalp EEG, computed the instantaneous phase of EEG signals using the Gabor wavelet transform, and used phase locking value (PLV) to estimate the degree of phase synchrony between EEG signals. Long-lasting beta-band (13-25Hz) phase synchrony between frontal and parietal electrode pairs was observed more prominently in the mismatch condition than in the match condition. We interpret this finding as reflecting effortful auditory-visual integration when the sound mismatched the shape. The PLV analyses not only revealed that preverbal infants were able to detect sound symbolism but also revealed that there are differences in the dynamical networking for processing sound-symbolically matched and mismatched auditory-visual information.

B37

CONTRASTING INFANTS WITH A FAMILY HISTORY OF SPECIFIC LANGUAGE IMPAIRMENT TO THOSE WITH A FAMILY HISTORY OF DYSLEXIA: CONTINUUM OR DISCRETE GROUPS? Naseem Choudhury[1,2], April Benasich[2]; [1]Ramapo College of New Jersey, [2]Rutgers, Newark — The ability to perform fine-grained acoustic analysis in the tens of millisecond range during infancy has been shown to be a robust predictor of language development and disorders. Here the early processing abilities of infants at higher risk for language impairment as a function of family history of Specific Language Impairment (FH+SLI, n=11) or Dyslexia (FH+Dys, n=10) were compared to control children (FH-/Ctrl, n=10) using scalp electrocortical recordings (ERPs). An oddball paradigm to complex tone-pairs (standard:100-100 Hz, deviant:100-300 Hz [15%]) with 300ms or 70ms ISI was employed. ERP morphology suggests significant differences in early obligatory and auditory detection components for the 70ms ISI stimuli only. Infants in the FH+SLI group showed significantly larger P1 peaks as compared to FH+Dys and FH-/Ctrl groups (1.24?V versus 0.35 & 0.5?V, respectively) and absent N2 peaks. Differences were also observed on the subtraction waveform: while there were no differences in the MMR latency between FH-/Ctrl (400ms) and FH+Dys (420ms) infants, the peak latency in the FH+SLI group was delayed (500ms). FH+Dys infants, however, showed significantly weaker MMR responses as compared to other groups. Association between infants ERPs and 3-year language abilities revealed a continuing impact of poor auditory processing. Infants with faster N2 latencies and more robust MMR's had better expressive language scores (R2= 0.25 – 0.15, p<.05). These findings suggest differences in basic auditory detection and discrimination processes of infants with familial risk factors and that familial risk for SLI and/or dyslexia differentially affect early auditory processing mechanisms.

B38

MATURATIONAL DIFFERENCES IN LANGUAGE-RELEVANT FRONTOTEMPORAL WHITE MATTER FIBER TRACTS Michael A. Skeide[1], Jens Brauer[1], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Frontotemporal brain areas are crucially involved in processing various types of linguistic information both in the syntax and the semantics domain. Although progress has been made in exploring the cortical connectivity of perisylvian language areas (Dehaene-Lambertz, 2006; Friederici, 2009) further research is needed to achieve a detailed understanding of language-related structural maturation stages in the developing brain. In the present diffusion-weighted imaging study we investigated differences between perisylvian white matter fiber tracts in 3-4-year old and 9-10-year old children as well as adults. To tackle this issue, we directly compared fractional anisotropy (FA) values between whole brain white matter skeletons for each group running a tract-based spatial statistics (TBSS) analysis. In the older child group significantly higher FA values ($p<0.01$, threshold-free cluster enhancement corrected) compared to the younger child group were found in various cortical and subcortical regions including the inferior frontal gyri (IFG) and the superior temporal gyri (STG). Remarkably, FA differences where more robust and broader in the left IFG and to a lesser degree in the left posterior STG. A similar comparison of FA values between 9-10-year old children and adults still revealed significant differences in both the IFG and the STG. However, these effects were less robust and less left-lateralized. Results indicate ongoing neuronal maturation, presumably fiber myelination as well as increasing axonal density, in frontotemporal neural language networks of the developing brain. Although this process is much more pronounced between 3-4-years and 9-10-years of age it seems to continue into adulthood.

B39

ANATOMICAL CORRELATES OF SPOKEN NARRATIVE PERFORMANCE IN CHILDREN WITH HIGH FUNCTIONING AUTISM Brian Mills[1], Pamela Moses[1], Janie Lai[1], Matt Ignacio[1], Judy Reilly[1], Matt Erhart[2], Tim Brown[2], Mark Appelbaum[2]; [1]San Diego State University, [2]University of California, San Diego — Autism is a neurodevelopmental disorder characterized by deficits in language and communication. Previous research examining cortical thickness in regions central to language has shown abnormalities in autism. Studies correlating language performance and cortical thickness often rely on standardized language tests. However, these studies provide a limited portrait of language ability and do not examine language in real world contexts, namely spoken discourse. In the current study, 16 typically developing (TD) children and 11 children with high functioning autism (HFA) ages 8-12 told a story of an instance when they had a conflict with another person. Spoken narratives were scored for length, syntactic complexity, and narrative structure. In addition, children were administered the Clinical Evaluation of Language Fundamentals (CELF). Structural magnetic resonance imaging data were measured for cortical thickness in classic language regions. Results for the spoken narrative measures in the HFA group revealed a positive correlation between cortical thickness and language performance; the thicker the cortex, the better the language score. In contrast, the TD group shows a negative or absence of correlation across narrative measures. For the standardized CELF measures, there were no group differences in correlations between thickness and performance. Further, Performance IQ did not show group differences in relation to cortical thickness. Children with HFA show a distinctly different relationship between language and cortical development and this aberrant relationship appears to be specific to spoken narrative language. A delay or reduction in normal developmental pruning may support better narrative performance in HFA.

B40

RESTING GAMMA POWER AS AN INDEX OF MATURATIONAL RATE. Adam Tierney[1], Dana Strait[1], Nina Kraus[1]; [1]Northwestern University — Gamma oscillations have been associated with a wide variety of cognitive and perceptual processes, including visual short-term memory, spatial attention, selective attention, and object perception. Little is known, however, about the development of spontaneous gamma oscillations during adolescence and its relationship with cognitive and perceptual abilities. Here, we collected ongoing EEG from subjects aged 14-16.5 while they sat quietly with their eyes open. Results reveal that resting gamma power decreases between ages 14 and 15 (early adolescence) but then remains stable for ages 15 and 16.5 (later adolescence). Moreover, early but not late adolescent subjects demonstrated correlations between resting gamma power and reading and language perception, such that lower gamma power was linked to better performance. These results suggest that resting gamma power can be used as an index of maturational progress in adolescence and that reading and speech-in-noise abilities are particularly sensitive to differences in maturational rate. Supported by training grants T32 DC009399-02 and F31DC011457 and a grant from the G. Harold and Leila Y. Mathers Foundation.

B41

ELECTROPHYSIOLOGICAL RECORDINGS OF BRAIN ACTIVITY IN PRESCHOOLERS REVEALS THE CONCEPTUAL PROCESSING OF SPOKEN NUMBER WORDS Michal Pinhas[1], Sarah Donohue[1], Marty Woldorff[1], Elizabeth Brannon[1]; [1]Duke University — A handful of studies have explored the neural correlates of numerical cognition in young children aged 5 and younger; no studies, however, have investigated the learning and processing of spoken number words. This is a gap in the literature, given the substantial controversy over (a) why children seem to learn the meaning of number words very slowly, and (b) whether children rely on the approximate number system when they first map number words onto preverbal representations (e.g., Carey, 2009; Gelman & Gallistel, 1978; Wynn, 1990; 1992). Here we use event-related potentials (ERPs) to study neural processing related to number-word comprehension in 4- and 5-year-old children. We used a picture/spoken-word match-mismatch paradigm analogous to toddler word-learning ERP studies (e.g., Friedrich & Friederici, 2004). Children heard the spoken number words one, two, three or six while looking at pictures of 1, 2, 3 or 6 objects, with the number word being incongruent with the number of visual objects on half the trials, and congruent on the other half. Incongruent number words, relative to congruent ones, elicited a long-lasting, frontocentral, negative-polarity ERP wave onsetting at ~200 ms, presumably reflecting the detection of the numerical inconsistency. Preliminary analysis suggests this enhanced negative wave for incongruent trials was also modulated by the numerical difference between the number word and the visual image. These results provide the first neural correlates of spoken number-word comprehension in preschoolers and establish a basis for studying younger children as they learn the meaning of number words.

LONG-TERM MEMORY: Development & aging

B42

DIFFERENCES IN BRAIN ACTIVITY DURING A VERBAL ASSOCIATIVE MEMORY ENCODING TASK IN HIGH AND LOW-ACTIVE ADOLESCENTS Megan M Herting[1], Bonnie J Nagel[1]; [1]Oregon Health & Science University — Aerobic exercise is not only good for the body but also benefits the brain. Greater aerobic fitness relates to better memory, as well as brain function in elderly adults and preadolescent children. However, the impact of exercise on the adolescent brain has received little attention, and no study has explored how exercise may influence brain activity during the encoding of new memories. Here we examined brain activity in 15 high-active (age=16.2, SD=.9) and 11 low-active (age=16.5, SD=.8) male adolescents during a verbal associative memory encoding task. Participants were presented with a series of novel word pairs to learn during a functional magnetic resonance imaging (fMRI) scan, and then performed a post-scan recognition task. Voxelwise ANCOVA were used to examine group differences in blood oxygen level dependent (BOLD) signal during encoding of word pairs subsequently remembered with high confidence compared to those later forgotten. Despite equivalent task performance, low-active youth displayed greater BOLD signal in a number of memory-related brain regions compared to high-active youth during encoding of remembered versus forgotten word pairs ($p<0.05$, multiple comparison corrected), including the left middle temporal gyrus, superior frontal gyrus, and inferior frontal gyrus. This is the first study to show that aerobic fitness impacts adolescent memory-related brain response using functional MRI. These findings may reflect compensatory brain activity necessary for low-active youth to accomplish comparable task performance to their high-active peers. Taken together with previous research on children and elderly, these findings provide further evidence that exercise influences the brain across the lifespan.

B43

AEROBIC FITNESS ENHANCES RELATIONAL MEMORY IN PREADOLESCENT CHILDREN: THE FITKIDS RANDOMIZED CONTROL TRIAL Jim M. Monti[1], Charles H. Hillman[1], Neal J. Cohen[1]; [1]University of Illinois at Urbana-Champaign — It is widely accepted that aerobic exercise enhances hippocampal plasticity in non-human animal models. Often, this plasticity co-occurs with gains in hippocampal-dependent memory. Cross-sectional work investigating this relationship in preadolescent children has found behavioral differences in higher versus lower aerobically fit participants for tasks measuring relational memory, which is known to be critically tied to hippocampal structure and function. The present study tested whether similar differences would arise in a clinical intervention setting where a group of preadolescent children were randomly assigned to a nine-month after school aerobic exercise intervention versus a wait-list control group. Specifically, 53 children (mean Age = 9.45 years) were randomized to an afterschool physical activity intervention which met each school day, versus to a wait-list control group who performed their normal afterschool activities. Results indicated that children in the intervention increased their aerobic fitness, whereas no change in fitness was noted for the control group. Performance measures included eye-movements as a measure of memory, based on recent work linking eye-movement indices of relational memory to the hippocampus. Compared to the control group, those who entered the aerobic exercise program displayed eye-movement patterns indicative of superior memory for face-scene relations, with no differences observed in memory for individual faces. These results (1) support the view that the hippocampus is critical for memory for relations amongst items, (2) indicate the positive influence of increased aerobic fitness on hippocampal-dependent memory, and (3) emphasize the utility of using eye-tracking as a method to study memory. Funded by NIH HD055352.

B44

AUTOBIOGRAPHICAL RETRIEVAL IN HEALTHY OLDER ADULTS Jaclyn Ford[1], David Rubin[2], Kelly Giovanello[1]; [1]University of North Carolina at Chapel Hill, [2]Duke University — Research suggests that significant age-related changes are apparent in autobiographical memory retrieval when the qualitative content of the memories is examined. For example, older adults tend to retrieve autobiographical information that is overly general (i.e. not restricted to a single event) relative to young adults' specific memories (the overgenerality effect). Additionally, older adults retrieve memories that are rated as more positive overall relative to those of young adults. This positivity effect has been extensively reviewed in the episodic memory literature, but had been less researched in autobiographical memory. Although these two effects have been investigated independently, no studies have examined how these aging effects relate to one another at the neural level. An event-related functional neuroimaging study was conducted to examine the neural networks recruited by autobiographical memory retrieval in healthy young and older adults. Music was selected as a retrieval cue due to its unique capability to elicit

specific emotional memories without explicit retrieval instructions. Neural activity during young and older adults' positive and specific autobiographical memories were compared, focusing on regions preferentially engaged in older adults' memory retrieval. Preliminary analysis suggests that young and older adults rely on distinct cognitive and neural mechanisms during retrieval of autobiographical memories. Understanding how healthy aging influences older adults' autobiographical memory retrieval provides valuable insight into how memory representations change with time, experience, and cognitive manipulations. As autobiographical memory is particularly important to older adults' daily functioning and sense of well being, this information may be invaluable for the aging population.

B45

LONGITUDINAL ASSOCIATIONS BETWEEN PHYSICAL ACTIVITY, COGNITIVE STATUS, AND BRAIN FUNCTION IN OLDER ADULTS AT GENETIC RISK FOR ALZHEIMER'S DISEASE J Carson Smith[1,2], Sally Durgerian[2], John L. Woodard[3], Kristy A. Nielson[4,2], Alissa M. Butts[4], Nathan Hantke[4], Michael Seidenberg[5], Melissa A. Lancaster[5], Monica Matthews[5], Michael A. Sugarman[3], Stephen M. Rao[6]; [1]University of Maryland, [2]Medical College of Wisconsin, [3]Wayne State University, [4]Marquette University, [5]Rosalind Franklin University of Medicine and Science, [6]Cleveland Clinic — The apolipoproteinE epsilon4 (APOE-?4) allele is associated with cognitive decline in old age and is a risk factor for Alzheimer's disease (AD). Physical activity (PA) is associated with a reduced risk of incident cognitive impairment, particularly among APOE-?4 carriers. We recently reported greater semantic memory related brain activation in cognitively intact physically active (High PA) APOE-?4 carriers compared to physically inactive (Low PA) ?4 carriers and non-carriers (Smith et al., 2011). Here, we compared longitudinal changes in semantic memory-related brain activation in High PA and Low PA APOE-?4 carriers. Thirty-two older ?4 carriers completed neuropsychological testing and a fMRI semantic memory task (famous name discrimination) at baseline and after 18 months. All participants were cognitively intact at baseline and were classified as High PA (n = 16) or Low PA (n = 16) based on self-report. After 18 months, 5 of 16 High PA and 13 of 16 Low PA were classified as cognitively declining by at least 1 SD decrease in neurocognitive performance (Group difference, p = .011, Fisher's exact test). A fROI analysis of the fMRI data and repeated measures ANOVAs revealed significant Group by Time interactions for intensity of semantic memory-related activation. Significantly greater activation at baseline in the High PA group was attenuated over time (no change in Low PA) and resulted in no group differences at the 18-month follow-up. These findings suggest that greater PA at baseline is associated with greater cognitive stability over 18-months in APOE-?4 carriers and reduced neural activation during fame discrimination.

B46

CEREBRAL AND VASCULAR FACTORS MAY PREDICT MEMORY PERFORMANCE IN HEALTHY AND PATHOLOGICAL AGING Jil Humann[1], Anouk Vermeij[1,2], Arenda H.E.H. van Beek[2], Ondine van de Rest[2], Jurgen A.H.R. Claassen[1,2], Roy P.C. Kessels[1,2]; [1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, The Netherlands, [2]Radboud University Nijmegen Medical Centre, Alzheimer Centre Nijmegen, The Netherlands — Aging is associated with several changes to the structure and function of the brain and vasculature. This study aimed to investigate the relationship between cerebral and vascular factors that may play a role in the development of Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD), and associated cognitive impairments. Participants were 27 healthy older adults (76.3±4.1 years), 21 MCI patients (71.8±9.2 years) and 22 AD patients (73.0±6.8 years). We rated the degree of medial temporal lobe (MTL) atrophy on coronal T1-weighted MRI, and white matter hyperintensities on transverse T2-FLAIR MRI images. We measured blood pressure (BP) and cerebral blood flow velocity (CBFV, Transcranial Doppler) under resting conditions, and calculated cerebrovascular resistance (CVR). Additionally, participants performed the Dutch equivalent of the Rey auditory verbal learning task. Preliminary results showed that both structural and vascular measures predict memory performance. Specifically, when corrected for age and education, low performance on the memory task was associated with high rates of atrophy (r= -.588) and white matter degeneration (r= -.450) as well as higher CVR (r= -.314). AD patients compared to healthy controls exhibited higher rates of both MTL atrophy and white matter lesions. Furthermore, CVR was higher in patients (both MCI and AD) than in controls. Since we did not observe differences in CBFV between groups, this seems to be related to heightened mean BP in the patient group. These results suggest reciprocal interactions between structural pathology, vascular changes and cognitive performance during aging and support the idea that cerebrovascular dysfunctions may cause AD.

B47

ROLE OF RECOLLECTION IN EPISODIC FEELING-OF-KNOWING ACCURACY IN YOUNG AND OLDER ADULTS Michel Isingrini[1], Audrey Perrotin[1], Celine Souchay[1], Laurence Taconnat[1], Mathilde Sacher[1], Badiaa Bouazzaoui[1]; [1]University of Tours, France — In feeling of knowing (FOK) studies, participants predict subsequent recognition memory performance on items initially encoded but that cannot be recalled. This study examined the hypothesis that FOK accuracy may be influenced by the recollection of contextual information related to the unrecalled target by asking participants to indicate whether the information on which they based their prediction of future recognition was related or not to the contextual episode of learning. Such procedure enabled to distinguish two type of episodic FOK accuracy, associated to the recollection of the context information (R-FOK) or not (NR-FOK). In addition, we tested whether the episodic FOK accuracy deficit demonstrated by older adults could be reduced. Results confirmed that R-FOK accuracy was significantly higher than NR-FOK accuracy confirming that the recollection of contextual information enhanced episodic FOK. However, this was not the case for older adults indicating that, contrary to the younger adults, they do not benefit from this recollection effect. This suggests a lack in older adults in the quality of contextual details retrieved pertaining to the unrecalled target that are required to make accurate FOK judgments.

B48

SLEEP-DEPENDENT MEMORY CONSOLIDATION IN OLDER ADULTS – A PILOT STUDY Kathryn Atherton[1], Christopher Butler[1], Anna C Nobre[1]; [1]University of Oxford — There is now a large body of evidence demonstrating that sleep plays a role in memory consolidation. The overwhelming majority of these studies have used young adults as participants. There is evidence to suggest that there may be a decline in sleep-dependent memory consolidation with age. Here we present data showing that sleep is very beneficial for memory even in older adults (mean age 59±1.65). Participants learnt new arbitrary associations between pairs of word stimuli. Memory was tested twelve hours later following a night of sleep or a day of wake. Interfering pairs of words were learnt ten minutes before the memory test. This interference learning has been shown in previous studies with young adults to 'unmask' the benefit of sleep for memory. Each participant took part in both conditions and the order was counterbalanced. Retention was significantly better in the sleep condition than the wake condition. Learning was not significantly different in the two conditions, arguing against a circadian interpretation of the data.

B49

AGE-RELATED AND GENETIC EFFECTS ON FUNCTIONAL REORGANIZATION OF MEMORY SYSTEMS Nicolas Schuck[1,2], Peter Frensch[1], Shu-Chen Li[2]; [1]Humboldt-Universität zu Berlin, [2]Max-Planck Institute for Human Development, Berlin — Aging research shows that some forms of memory are more affected by aging than others. Intriguingly, this research has revealed a mismatch between age-related behavioral and neurophysiological decline for the habitual/procedural and declarative memory systems: behaviorally the former exhibits smaller age-related decline than the later, while negative effects of aging on the associated

brain networks, striatum and medial-temporal lobe (MTL), respectively, are comparable. We present data that shows that (a) key memory functions attributed to the striatum and the MTL, i.e., habit-like, reinforcement based memory and flexible, declarative memory, respectively, show differential age effects and (b) behavioral correlations between skill and declarative memory differ between age groups. Furthermore, preliminary results from the already genotyped subsample hinted at effects of genotypes affecting neuromodulatory processes. Our data is in line with the proposal that neural correlates of memory systems change across age. Accordingly, we suggest that both aging and individual differences in genetic predispositions affect the functional organization of memory systems in the brain. More specifically, we propose that age-related and individual differences in neuromodulation could contribute to functional reorganization of memory systems that preserves non-declarative, habit like memory functioning in old age to some extent.

B50

EVENT-RELATED POTENTIALS (ERPS) REFLECT A DISTINCTIVE FRONTAL ACTIVITY IN A FEATURE-BASED OBJECT KNOWLEDGE RETRIEVAL PROCESS IN AGING Hsueh-Sheng Chiang[1], Raksha Anand Mudar[1,2], Elizabeth Kanter Bartz[1], Michael Kraut[3], John Hart Jr.[1]; [1]Center for BrainHealth, The University of Texas at Dallas, [2]Department of Speech & Hearing Sciences, The University of Illinois at Urbana Champaign, [3]Department of Radiology, The Johns Hopkins University School of Medicine — In the course of aging, qualitative changes in certain aspects of semantic memory processing occur. We explored the effects of aging on the electrophysiological correlates of feature-based object memory retrieval. We used a task that required subjects to respond whether two presented words (e.g., humps and desert) retrieve the memory of an object (in this case, camel; the "retrieval" condition) or not (the "non-retrieval" condition). We administered this task while we recorded scalp EEG in 17 young adults (mean age: 21.5 years, 7 males) and 17 older adults (mean age: 63.5 years, 2 males). We found that RT was longer in the non-retrieval trials compared to the retrieval trials in both groups ($p < .001$). While older adults had higher accuracy in the non-retrieval than they did in the retrieval trials ($p = .002$), young adults had comparable accuracy in both conditions. In the younger subjects we found a frontal central scalp-surface negative potential between 500 and 800 ms post-stimulus that was more negative in the non-retrieval trials than in the retrieval trials ($p = .008$). By contrast, the older subjects demonstrated a later frontal positive-going waveform between 800 and 1000 ms post-stimulus, with the non-retrieval trials eliciting larger responses than did the retrieval trials ($p = .009$). These findings indicate distinct neural correlates of object memory retrieval process in older adults that might suggest a strategy difference in semantic processing.

B51

THE ROLE OF RECOLLECTION IN SOURCE MEMORY PARADIGMS DURING EARLY CHILDHOOD: EVIDENCE FROM EVENT-RELATED POTENTIALS Leslie Rollins[1], Tracy Riggins[1]; [1]University of Maryland, College Park — Improvements in children's memory stem from: 1) accurately identifying previously encountered items, 2) recalling contextual details associated with these items (e.g., location), and 3) resisting falsely identifying novel items as previously encountered (i.e., committing false alarms (FA); Lloyd, Doydum, & Newcombe, 2009; Drummey & Newcombe, 2002). The current study assessed these abilities in 31 young children (M = 5.57 years, SD = .33, 15 males) using a behavioral source memory paradigm and event-related potentials (ERPs). Children encountered items in two distinct locations. One week later, children's memory for items and their locations was assessed as well as their ability to reject new items (including items similar and dissimilar to the old items). Regression analysis revealed that FA to similar novel items ($b = -.22$, $t(27) = -2.47$, $p < .05$) predicted memory for location whereas FA to dissimilar novel items and memory for individual items did not. Children were then separated into two groups based on the number of FAs committed. The low FA group (n=15) was marginally more likely to remember the location of items than the high FA group (n=16), $t(29) = -1.94$, $p = .06$. The low FA group showed ERP episodic memory effects. A recollection effect was present over frontal leads during 300-600 ms and 800-1200 ms time windows. These ERP effects were not present in the low FA group. These results suggest that individual differences in recollection underlie memory for contextual details and the rejection of similar novel items in childhood.

B52

HIPPOCAMPAL SUBFIELDS VOLUMES REVEAL SPECIFIC MEMORY DEFICITS IN MILD COGNITIVE IMPAIRMENT Josiah Leong[1], William Irwin[1], Howard Rosen[1], Bruce Miller[1]; [1]University of California, San Francisco — Performance for persons with mild cognitive impairment (MCI) has been reliably shown to be related to volumetric measures of the hippocampi. Various magnetic resonance imaging (MRI) techniques have documented atrophy of the hippocampi in elderly people with neuropsychological indices of MCI. Thus, the utility of MRI techniques have been increasingly employed to examine memory, dementia, and aging both for diagnosis and prospective treatments. Our goal was to identify relations between hippocampal subfields and specific domains of memory performance. Physiological studies have emphasized immediate recall is related to the volume of the dentate gyrus and CA1 regions, whereas delayed recall is related to entorhinal cortical volume. The Auditory Verbal Learning Test provided a unique measure to investigate the role of these regions, iv vivo, in the human brain. Participants were read 15 words, thereafter tested for immediate recall; this procedure was repeated 5 times in succession. Verbal recall was tested after a distraction task, and again 30 minutes subsequent, followed by visual recognition of the test items. Twelve subjects (5 control, 7 MCI) underwent neuropsychological testing and a MRI protocol including a 3-dimensional, T1-weighted sequence (3.0 Tesla Siemens TIM Trio). Data were collected as part of the Alzheimer's Disease Neuroimaging Initiative (ADNI). FreeSurfer (version 5.1.0) was used to segment hippocampal subfields. Our findings demonstrate hippocampal subfield volumes are differentially related to performance on specific memory indices.

B53

AGE-RELATED DIFFERENCES IN THE CONSOLIDATION OF MEMORY TRACES Karolina Janacsek[1], Dezso Nemeth[1,2]; [1]University of Szeged, Szeged, Hungary, [2]University of Texas, Austin — Memory formation does not occur only during learning, in the online periods, but also between practice sessions, during the offline periods. The process that occurs during the offline periods is referred to as consolidation, which denotes the stabilization of a memory trace after the initial acquisition; this can result increased resistance to interference or even improvement in performance following an offline period. Although a growing body of research advances our understanding of age-related deficits in online learning, little is known about the effects of aging on consolidation and its time course. We studied aging effects on the time course of consolidation. Young and elderly adults performed a probabilistic implicit sequence-learning task before and after a 12-hour, a 24-hour and a 1-week interval. The task enabled us to separate two components of learning and consolidation: 1) general motor learning (primarily based on the general familiarization with the task requirements) and 2) sequence-specific learning. We found offline improvement of general motor learning with a higher degree in the young groups. The elderly adults showed enhancement after the 12-hour period. However, this improvement disappeared in the 24-hour and the 1-week delay conditions. Regarding sequence-specific learning, no improvement was found in either age group and at either consolidation interval. In contrast, sequences-specific knowledge decreased in the elderly group independently of the delay. These results draw attention to the fact that consolidation is not a single process; rather there are multiple mechanisms which are differentially affected by time course and by aging.

B54

ENHANCED PREFRONTAL AND MEDIAL TEMPORAL ACTIVATION CHARACTERIZES COGNITIVE MAINTENANCE OVER TWO DECADES Sara Pudas[1], Jonas Persson[1], Maria Josefsson[2], Xavier de Luna[2], Lars-Göran Nilsson[1], Lars Nyberg[2]; [1]Stockholm University, [2]Umeå University — Participants from a population-based longitudinal study (N=1558) were classified as either cognitive maintainers or average performers based on the change of an episodic memory score, measured four or five times during 15-20 years. The classification procedures took into account both initial test score and rate of change, and factored in scores from drop-outs in order to control for attrition. Fifty-two maintainers and 52 age-matched average performers (M=68 years, range 55-80) underwent functional magnetic resonance imaging during an episodic memory face-name paired associates task. Maintainers displayed increased activation, relative to average performers, in left prefrontal cortex, anterior cingulate, left hippocampus as well as right parahippocampal gyrus during episodic encoding. Activity in the medial temporal clusters was correlated to task performance and thus interpreted as contributing to the superior task performance of maintainers, while the frontal activity was hypothesized to reflect more general cognitive control processes. Activation differences could not be directly attributed to differences structural brain integrity between the groups. The current result help to elucidate the neural correlates of successful cognitive aging, potentially providing a reference point for medical and cognitive training interventions aimed at preventing age-related cognitive decline.

PERCEPTION & ACTION: Development & aging

B55

AGE-RELATED CHANGES IN THE NEURAL CORRELATES OF TEMPORAL DECISION-MAKING Cutter Lindbergh[1], Paul Kieffaber[1]; [1]The College of William and Mary — Nearly every psychological model that has been proposed to account for the ability to keep track of time involves a clock component, a memory component, and a decision component. Although older adults have been shown to exhibit behavioral deficits in mental timekeeping, there has been a paucity of research mapping the origins of these deficits to specific components of the temporal processing system. The present study employed electroencephalography to determine the integrity of the temporal processing system during aging as well as the specific component(s) that may play a role in age-related timing dysfunction. Twenty older adults and twenty younger adult controls completed a temporal bisection task, which required temporal judgments to be made about visual stimuli ranging from 1250 to 3000 milliseconds (ms) in duration. Significant abnormalities in event-related brain potentials at 200 to 700 ms post stimulus offset were observed in older adults. This finding suggests that the behavioral timing deficits observed in older adults have their origins in the decision-making component of the temporal processing system.

B56

THE EARLY DEVELOPMENT OF THE MIRROR MOTOR SYSTEM: INSIGHT FROM AN EMG STUDY IN INFANTS Nadia Bolognini[1], Irene Senna[1], Elena Natale[1], Marta Picozzi[1], Elena Longhi[1], Viola Macchi Cassia[1], Chiara Turati[1]; [1]Department of Psychology, University of Milano-Bicocca — Seminal studies in monkeys and humans suggest the existence of a mirror neuron system (MNS) that maps visual descriptions of actions done by others onto the observer's motor representations of the same actions (Rizzolatti & Craighero, 2004). This mechanism allows the observers to have an internal copy of the observed action, enabling them to understand directly the agent's intention. So far, little is known about the origins and development of the human MNS. Using electromyographic recordings (EMG), we explored in healthy full-term infants aged 3 and 6 months whether action observation can induce covert activation of the muscles responsible for the final action goal. EMG was recorded from muscles responsible of mouth opening while infants watched two video-clips displaying an agent either reaching an object and bringing it to the mouth (i.e., mouth action) or reaching an object and placing it on the head (i.e., head action). At 6 months of age, we found a mirror motor facilitation contingent upon observation of the mouth action, while observing the head action decreased the motor activation. Motor activity was specifically modulated during the bringing phase, but not during reaching and grasping phases. Instead, at 3 months there was no mirror motor modulation according to the goal of the observed action during any of the actions phase. These findings strongly argue for an involvement of the human MNS in action understanding early in development, but also speak in favour of a gradual development of mirror mechanisms rather than of a prewired innate MNS.

B57

SEQUENCE-SPACE ASSOCIATIONS IN PRE-LITERATE CHILDREN Laura Gibson[1], Daphne Maurer[1]; [1]McMaster University — Associations between sequences and space are ubiquitous and robust in adulthood. There is some evidence that these associations are based in literacy; for example, English-speaking adults tend to perceive sequences as beginning on the left and progressing towards the right side of space, while adults in cultures that read from right to left exhibit the opposite tendency (e.g., Zebian, 2005; Shaki et al., 2009). However, there is also evidence that neonatal chicks perceive sequences as beginning on the left side of space (Rugani et al., 2010). These results suggest that the cortex may preferentially process sequences arranged from left to right, perhaps as a result of a natural inclination stemming from right-hemisphere dominance in visuo-spatial tasks, but that this initial bias may be overridden with exposure to cultural reading direction. To test this hypothesis, we examined sequence-space associations in preliterate children. Five-year-olds were asked to assign box locations to items in two familiar ordinal sequences: numbers 1, 2, and 3, and breakfast, lunch, and dinner. Children ordered numbers from left to right significantly more often than would be expected by chance (81%; p=0.021); but responded randomly in ordering meals (43%; p=0.791). Our results suggest that children do exhibit a left-to-right bias prior to learning to read; however, this left-to-right mapping may be restricted to sequences frequently encountered in ordered print (1,2,3) and not those they understand (breakfast, lunch, dinner) but do not encounter regularly in print. These data support the role of experience in the development of sequence-space associations.

B58

EFFECT OF COMT VAL158MET GENOTYPE ON AGE-RELATED MOTOR DECLINE Fatemeh Noohibezanjani[1], Nathaniel Boyden[1], Jenn Humfleet[1], Youngbin Kwak[2], Nicolaas Bohnen[1], Martijn Muller[1], Joshua.L West[1], David.T. Burke[1], Rachael.D. Seidler[1]; [1]University of Michigan, [2]Duke University — Motor decline in older adults has been linked to age-associated dopaminergic denervation. Genetic polymorphisms of the Catechol-O-methyltransferase (COMT) enzyme partially determines cortical dopamine availability. Individuals homozygous for the methionine allele (met-met) show reduced cortical COMT enzymatic activity, resulting in an increase of dopamine levels in the prefrontal cortex. This is in contrast to individuals homozygous for the valine (val-val) allele. We hypothesize that motor performance will be worse in individuals with at least one val allele, and this effect will be mediated by age. Female participants; 58 Older adults (OA), mean age 70.5 yrs, and 72 young adults (YA), mean age 21 yrs with no history of stroke or neurological disease performed a manual sensory adaptation task and a manual explicit learning task. Repeated measures ANOVA showed an age group effect for both motor learning tasks ($F=6.917$, $p=0.01$ and $F=54.025$, $p < 0.01$, for the sensorimotor and sequence learning tasks, respectively). However, there was no significant main effect of genotype in either task, although there was a statistical trend ($p=0.092$) in the sensorimotor task showing that val-val homozygotes performed better on average than either val-met or met-met individuals. Additional participants will be added to the analyses as genotype data becomes available. We also plan to examine the effects of DRD2 and BDNF genotypes.

B59

MOTOR PROCESSING DURING GESTURE PERCEPTION ACROSS DEVELOPMENT: AN FMRI STUDY Elizabeth Wakefield[1], Karin H. James[1]; [1]Indiana University — Visual object perception is affected, both behaviorally and neurally, by our history of actions with objects. Our actions serve to change the information stored about objects, as evidenced by the broader neural system associated with objects that have been acted upon. This extended system includes the posterior middle temporal gyrus and the premotor cortex. Interestingly, these regions are also recruited during the perception of manual gesture produced by another during speech. This common activation suggests that gesture perception may also be reliant on our history of actions-specifically producing gesture while speaking. If gesture perception is affected by gesture production, then one would see differences in neural processing across development –given that gesture production changes dramatically during childhood. To address this question, three groups of children, 5.0-6.0, 7.5-8.5, and 10.0-11.0 year-olds, and adults watched movies in which an actor spoke a sentence and (1) performed no gesture, (2) performed a congruent iconic gesture, (3) produced the same iconic gestures, without speech during a functional Magnetic Resonance Imaging (fMRI) session. Results reveal dramatic changes in how gestures are processed in the MTG and premotor cortex across development. We suggest these differences arise from a difference in proficiency at integrating gesture information into semantic representations, driven by differences in production, thus demonstrating how action can drive our perceptual system.

B60

DURATION OF HEARING-AID USE PREDICTS CROSS-MODAL REORGANIZATION IN EARLY-DEAF PEOPLE Martha M. Shiell[1,2], Robert J. Zatorre[1,2], François Champoux[2,3]; [1]Montreal Neurological Institute, McGill University, [2]BRAMS International Laboratory for Brain, Music and Sound Research, [3]Université de Montréal — In early-deaf people, auditory cortical regions increasingly respond to visual motion. This phenomenon is referred to as cross-modal reorganization. Previous research has focused on people with profound deafness, with little consideration of people with residual hearing. As such, we do not know how varying degrees of auditory deprivation affect cross-modal reorganization. Based on the hypothesis that cross-modal reorganization in deaf people depends on auditory deprivation, we predicted that deaf people with less auditory deprivation, as measured by how long participants used a hearing-aid, will demonstrate less cross-modal reorganization. We recruited early-deaf people, with severe-to-profound hearing loss, who varied in their duration of hearing-aid use. We used fMRI to measure brain activity in auditory cortical regions while participants viewed moving and static visual stimuli. Visual motion activated the right-hemisphere planum temporale, an auditory association area. To test for a relationship between the duration of auditory deprivation and cross-modal reorganization, we entered each deaf participants' duration of hearing-aid use, in years, as a regressor in our analysis. Activity in the right-hemisphere planum temporale was related to hearing-aid use: Participants with longer duration of hearing-aid use demonstrated less activity. This relationship was largely driven by a sub-group of long-term hearing-aid users. We conclude that, although short-term hearing aid use does not have a clear effect, long-term hearing-aid use may prevent cross-modal reorganization. This knowledge is relevant, as cross-modal reorganization can interfere with rehabilitation of hearing loss through cochlear implantation.

B61

EVIDENCE FOR A SENSITIVE PERIOD ASSOCIATED WITH MUSICAL TRAINING: CHARACTERIZING DIFFERENCES IN GREY MATTER BETWEEN EARLY- AND LATE-TRAINED MUSICIANS Jennifer A. Bailey[1,2], Robert J. Zatorre[2,3], Virginia B. Penhune[1,2]; [1]Concordia University, [2]International Laboratory of Brain, Music and Sound Research, [3]McGill University — The idea of a sensitive period, a time during maturation when experience or stimulation has a greater influence on brain development, has been proposed for musical training (Watanabe et al., 2008). Early-trained musicians (ET) have demonstrated enhanced sensorimotor synchronization abilities compared to late-trained musicians (LT), even when matched for years of musical experience (Watanabe et al., 2008; Bailey & Penhune, 2010). However, the underlying differences in brain structure have yet to be explored. In this study, fifteen ET and LT adult musicians, matched for years of musical experience, were compared on a battery of musically relevant tasks. T1-weighted images (32 channel head coil; 1x1x1 mm3) were acquired in a Siemens 3T scanner. Differences in grey matter were analyzed using FreeSurfer (Dale, Fischl, & Sereno, 1999; Fischl & Dale, 2000). The groups were compared in terms of cortical thickness, cortical volume, surface area and mean curvature for specific regions of interest (ROIs). Preliminary analyses suggest increased cortical surface area in the pre-central, post-central, and inferior temporal gyri in the ET, as well as increased cortical volume of the superior frontal and transverse temporal sulci. Interestingly, thicker cortex in these ROIs was observed in the LT. Differences in mean curvature were also observed and will be considered when interpreting these findings. These results highlight the importance of characterizing differences in grey matter. In addition, these results suggest that early musical training influences brain structure differently than when the training is received later in development, when the brain regions involved are more mature.

THINKING: Decision making

B62

ANTERIOR CINGULATE CORTEX SIGNALS MULTIPLE PREDICTED OUTCOMES OF ACTIONS Andrew Jahn[1], Derek Nee[1], Joshua Brown[1]; [1]Indiana University — A number of theories have been proposed to account for the role of anterior cingulate cortex (ACC) and the broader medial prefrontal cortex (mPFC) in cognition. We recently proposed a new computational model of the mPFC, the prediction of response outcome (PRO) model, which casts the mPFC in part as learning to predict the various possible outcomes of actions. Simulations show that this new model can account for an unprecedented range of known mPFC effects. A key untested prediction of this model is that when multiple possible outcomes are anticipated to result from an action, the mPFC will be active in proportion to the number of predicted outcomes. Here, we test this hypothesis using fMRI and a task designed to manipulate the number of outcomes that subjects predicted, while controlling other confounding factors. We show that activations in the dorsal ACC increase with the number of predicted outcomes. Further, the dorsal ACC region showing this effect is distinct from regions involved in evaluating the predictions against the actual outcome. Whereas it is not clear how other existing theories of mPFC could account for these effects, they are consistent with predictions derived from the PRO model.

B63

VALUE AND PREDICTION ERROR IN THE HUMAN MEDIAL FRONTAL CORTEX: PUTATIVE INVOLVEMENT IN ADHD PATHOGENESIS Massimo Silvetti[1], Roeljan Wiersema[1], Edmund Sonuga-Barke[2], Tom Verguts[1]; [1]Ghent University, [2]University of Southampton — The many behavioral and physiological findings deriving from ADHD research defy a unified and satisfactory theory on its pathogenesis. Based on the evidence of mesolimbic dopaminergic deficit in ADHD, and on the recent findings on anterior cingulate cortex (ACC) involvement in reinforcement learning (RL), we propose a novel computational theory of ADHD pathogenesis. The core of this theory is a biologically plausible neural model of ACC, the Reward Value and Prediction Model (RVPM), representing both the ACC circuitry and its interactions with brainstem dopaminergic nuclei. We created an ADHD version of the model by decreasing its dopaminergic input to ACC. In a series of computer simulations, we tested the ADHD model in basic decision making processes (two armed bandit task), partial and continuous reward schedules, and immediate versus delayed rewards. The model was able to replicate the typical experimen-

tal findings comparing controls versus ADHD patients in these paradigms. At the behavioral level, the ADHD model showed impairments in reward-based decision making, a preference for immediate rather than for delayed rewards, and a performance recovery under a continuous reinforcement schedule. At the neurophysiological level the ADHD model showed impaired activity for reward expectations, impaired error-related responses, and a deficit of brainstem dopamine transfer from reward period to cue period. The RVPM provided a unified neurocomputational explanation for ADHD, from the neurophysiological to the behavioral level, with ACC playing a pivotal role. Finally the model was able to generate novel experimental predictions.

B64

INTRINSIC FUNCTIONAL CONNECTIVITY REFLECTS THE EFFECTS OF REWARD ON MULTIPLE LEARNING SYSTEMS. Juliet Y. Davidow[1], G. Elliott Wimmer[1], Juan Deliz[1], Itamar Kahn[2], Daphna Shohamy[1]; [1]Columbia University, New York, [2]Technion Israel Institute of Technology, Haifa, Israel — Converging evidence demonstrates that different kinds of learning depend on distinct neural systems. The hippocampus supports rapid encoding of single events, resulting in learning that has 'representational flexibility'. By contrast, the striatum is thought to support feedback-based gradual learning of stimulus-reward associations, resulting in learning that is inflexible and habitual. Open questions remain about how the striatum and hippocampus may interact to support flexibility for learned associations motivated by rewards. We employed a behavioral task that is thought to involve both forms of learning: incidental episodic encoding of relations between pairs of items, followed by incremental learning that some of these items are repeatedly paired with monetary reward. Critically, a subset of items overlapped in these two phases, which leads to flexible transfer of value from reward-associated items to the incidentally paired non-rewarded items. Emerging evidence suggests that such value transfer depends on hippocampal-striatal interactions during learning. Here, we sought to characterize this interaction using resting state functional connectivity. We explored the relationship between intrinsic functional connectivity in brain networks known to underlie reward learning and decision making, using regions of interest defined in an independent functional imaging study of the same task. Individual differences in performance on value transfer measures in our behavioral task relate to the individual differences in connectivity within reward networks in the brain. These results have implications for experience-guided decision-making, based on stimuli that are encountered together in the environment and followed by subsequent rewarding outcomes.

B65

EFFECTS OF DIFFERENT LEARNING STRATEGIES ON THE FEEDBACK-RELATED NEGATIVITY – EVIDENCE FROM THE WEATHER PREDICTION TASK Martina Rustemeier[1], Lars Schwabe[1], Christian Bellebaum[1]; [1]Ruhr University Bochum, Germany — The feedback-related negativity (FRN), an event-related potentials (ERPs) component observed following performance feedback in probabilistic learning tasks, has been hypothesized to reflect the activity of the midbrain dopamine (DA) system. Research on probabilistic categorization learning, however, has shown that the recruitment of the DA system depends on the strategy engaged during learning. Some subjects use non-declarative learning strategies, which are supposed to rely on the DA system, whereas others engage more declarative strategies that are dependent on the medial temporal lobe. We hypothesized that interindividual differences in the engaged learning strategy would be reflected in FRN amplitude. The participants of the present study performed a modified version of the 'Weather Prediction Task' (WPT) in which they learned probabilistic cue-outcome associations based on trial-by-trial feedback. Feedback processing was assessed with ERPs. By means of analysis of the individual choice patterns, subjects were divided into two groups: declarative learners (DL) and non-declarative learners (NDL). While FRN amplitude was higher for negative than positive feedback, NDL showed overall higher FRN amplitudes compared to DL. A group by feedback type interaction further revealed that amplitude differences between negative and positive feedback were more pronounced in NDL than in DL. Moreover, NDL were generally more successful in obtaining positive feedback. Our results suggest that the neural correlates of feedback processing depend on the strategy that is engaged in feedback-based learning. Additional analyses showed that learning success only played a minor role for the modulation of FRN amplitude.

B66

HEMISPHERIC EFFECTS ON STRATEGY UPDATING Elisabeth Stoettinger[1], Alex Filipowicz[1], Britt Anderson[1,2], James Danckert[1]; [1]Department of Psychology, University of Waterloo, [2]Centre for Theoretical Neuroscience, University of Waterloo — Does focal brain injury selectively and differentially impair strategy updating? We compared left brain damaged (LBD), right brain damaged (RBD) and control (CTRL) participants for strategy updating by having them play the game Rock, Paper, Scissors against a computer opponent that altered its strategy of play from a uniform selection to a strongly biased strategy of playing paper 80% of the time. CTRLs rapidly recognize this transition and adopt a probability matching strategy. LBDs also recognize the transition, but adopt a maximizing strategy: choosing scissors nearly 100% of the time. RBDs typically fail to note the transition, and continue to play an apparently random sequence of RPS. This impairment seems general as it was supported by the pattern of choices made on a computerized version of the Wisconsin-Card-Sorting-Test (Berg Card Sorting Task) where RBDs either failed to achieve a single correct category or took much longer to do so than did the LBDs and CTRLs. For RBDs there was a negative correlation between performance on the RPS game and the number of trials needed to sort the first category. Given that there was no indication of increased perseverative responding in the RBD patients we argue that their failure in the RPS task was not due to an inability to shift mental set, but instead reflects an inability to successfully develop a model.

B67

OVERRELIANCE OF HABITUAL OVER GOAL-DIRECTED ACTIONS IN PATIENTS WITH BIPOLAR DISORDER Woo-Young Ahn[1,2], Jeri S. Kent[1], Jerome R. Busemeyer[1], William P. Hetrick[1], Brian F. O'Donnell[1]; [1]Indiana University-Bloomington, [2]University of Illinois at Chicago — Individuals with bipolar disorder (BD) often show decision-making deficits on neurocognitive tasks. However, the precise cognitive and neural mechanisms underlying their deficits remain unclear. The current study aims to test two working hypotheses regarding their deficits. Patients with BD: (Hyp1) show an exaggerated response to negative feedback or (Hyp2) over rely on habitual actions versus goal-directed actions. Recent evidence suggests that habitual and goal-directed actions depend on distinct brain regions. We tested these hypotheses of decision-making deficits in BD by building reinforcement learning (RL) models that mimic each hypothesis (model-based and model-free RL) and an experimental design that can falsify these hypotheses. BD patients and healthy individuals completed two reversal learning tasks: the probability-tracking task and the probabilistic reversal learning task. Both tasks involve negative feedback. The behavioral results showed that: (1) BD patients performed similarly to healthy individuals in the stationary block, which is contrary to Hyp1; (2) However, BD patients performed significantly worse than healthy individuals and made more switches in the non-stationary stage. These behavioral results and preliminary modeling results support the hypothesis that their deficits are due to their overreliance on habitual actions over goal-directed actions, rather than their abnormal response to negative feedback. This study attempts to quantify learning strategy and reward learning deficits in BD patients by using a rigorous experimental design and mathematical modeling of their RL. We believe this is an important first step towards developing and testing more empirically-based methods for diagnosing, predicting, and ameliorating symptomatology in BD.

B68

COMMON PROCESSING OF EFFORT AND DELAY IN THE HUMAN BRAINSTEM Eliana Vassena[1], Massimo Silvetti[1], Wim Fias[1], Tom Verguts[1]; [1]Ghent University — Reward evaluation is encoded by dopaminergic activity in the brain (Schultz, 1998). However, for optimal learning and decision-making, the costs attached to the reward are to be considered as well. Lesion studies in animals confirm that costs, such as delay and effort, are taken into account (Rudebeck et al., 2006). fMRI experiments show that effort cost is integrated with reward (Croxson et al., 2009). Furthermore, they suggest that different areas selectively respond to different costs, though measured in a choice paradigm involving different tasks (Prevost et al., 2010). In fact, if and how multiple costs are integrated in a cost signal is still unclear. The goal of this fMRI study was to test for a common cost evaluation signal for effort and delay, addressing both costs in the same task and avoiding decision-making confounds. A good candidate for the current hypothesis was dopaminergic activity in midbrain and brainstem nuclei, known to be crucial in value estimation and recently proved to play a role in cost evaluation. Interestingly, conjoint activation for the effortful and delayed condition involves two separate areas in the brainstem, corresponding to Ventral Tegmental Area, known to be crucial in value prediction (Bromberg-Martin et al., 2010) and Dorsal Raphe Nucleus, consistent with recent findings in animals and humans (Miyazaki et al., 2011, Tanaka et al., 2004), and with theories of serotonin and dopamine interactions in cost and reward coding (Daw et al., 2002). This result provides evidence for a common cost signal in the brainstem.

B69

DEPRESSION IMPAIRS CHAINING WHEREAS SEROTONIN SPECIFIC REUPTAKE INHIBITORS IMPAIR CONTEXTUAL LEARNING IN PATIENTS WITH MAJOR DEPRESSIVE DISORDER Mohammad Herzallah[1,2], Joman Natsheh[1,2], Omar Danoun[2], Catherine Myers[1,3], Mark Gluck[1]; [1]Rutgers University-Newark, [2]Al-Quds University, Jerusalem, Palestine, [3]Veterans Affairs Medical Center - New Jersey Health Care System — In a study of chaining and context sequence learning, using the same task as that used in Nagy et al 2008, we tested never medicated Major Depressive Disorder (MDD) patients, Serotonin Specific Reuptake Inhibitors (SSRIs) treated MDD patients, and matched healthy control subjects. Never medicated MDD patients were the most impaired on the chaining phase of the sequence-learning task and this impairment was remediated with SSRI treatment, thus replicating results obtained in patients with Parkinson's disease (PD) with and without dopaminergic medication treatment using the same task. On the other hand SSRI treated MDD patients showed impairment on the context-learning phase, showing the same deficit as patients with mild cognitive impairment (MCI). These results are consistent with findings from previous research that MDD is associated with decreased levels of monoamines (serotonin, dopamine, norepinephrine). Conversely, these findings suggest that SSRIs might have detrimental effects on the medial temporal lobe (MTL) structures that were shown to be critical for contextual learning.

B70

DEPRESSION ENHANCES SENSITIVITY TO PUNISHMENT WHEREAS SEROTONIN SPECIFIC REUPTAKE INHIBITORS SUPPRESS SENSITIVITY TO PUNISHMENT IN PATIENTS WITH MAJOR DEPRESSIVE DISORDER Joman Natsheh[1,2], Mohammad Herzallah[1,2], Omar Danoun[2], Catherine Myers[1,3], Mark Gluck[1]; [1]Rutgers University-Newark, [2]Al-Quds University, Jerusalem, Palestine, [3]Veterans Affairs Medical Center - New Jersey Healthcare System — Using a reward and punishment learning task, we tested never medicated Major Depressive Disorder (MDD) patients, Serotonin Specific Reuptake Inhibitor (SSRI) treated MDD patients, and healthy control (HC) subjects. Never treated MDD as well as SSRI treated MDD patients achieved marginal, but similar, learning rates from reward stimuli, and therefore resembled the reward learning pattern of patients with Parkinson's disease (PD). On the other hand, never medicated MDD patients learned from punishment stimuli better than SSRI treated MDD patients. These results are consistent with findings from previous research that MDD is associated with decreased levels of monoamines (including dopamine) which were shown to be critical for learning from reward. Conversely, the suppressed sensitivity to punishment sheds the light on the role of monoamines as well as monoamine enhancement therapies (such as SSRIs) on learning from punishment.

B71

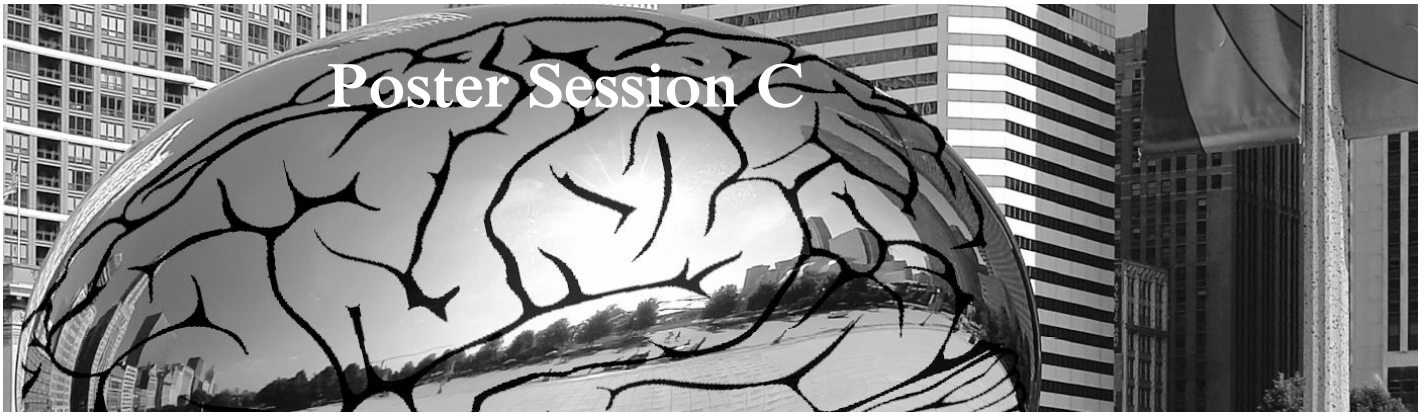
DECISION MAKING WITH EXPLICIT RULES AND EXECUTIVE FUNCTIONS IN PATIENTS WITH MULTIPLE SCLEROSIS Ashley D. Radomski[1], Christopher Power[1], Kenneth G. Warren[1], Ingrid Catz[1], Scot E. Purdon[1,2], Derek J. Emery[1], Esther Fujiwara[1]; [1]University of Alberta, [2]Alberta Hospital Edmonton — Multiple sclerosis (MS) is commonly associated with cognitive and emotional changes. We examined decision making using the Game of Dice Task (GDT) in MS patients with the relapsing-remitting (RR) or the secondary progressive (SP) MS-subtype. The GDT explicitly displays decision rules and probabilities for gains and losses. Thus, unlike the more common Iowa Gambling Task, it focuses more on cognitive/executive than emotional aspects of decision making. We hypothesized that 1) MS patients are impaired in decision making compared to controls, 2) GDT deficits are related to executive dysfunctions, 3) GDT deficits reflect brain atrophic processes in MS. The GDT and a standard neuropsychological battery were administered to MS patients (n=27) and healthy controls (n=25). Patients' enlargement of the third and lateral ventricles was studied with linear measurements on axial 5-mm T1-weighted MRI images. GDT netscores (risky minus safe decisions) were significantly lower in both patient groups than controls. Patients' problems in the GDT were due to poor utilization of negative response feedback. Composite performance in four cognitive domains (Processing Speed, Memory, Executive Functions: Inhibition, Planning), revealed RR MS-patients, but not SP MS-patients demonstrated a relationship between GDT netscores and (executive) Planning. GDT was unrelated to a variety of psychosocial and mood measures. Furthermore, the number of highest risk-level choices in the GDT was related to global brain atrophy (intercaudate nucleus distance) in patients, even when controlling for MS severity. In conclusion, MS patients' decision making deficits seem related to executive dysfunctions and brain atrophy in the course of their disorder.

B72

VENTROMEDIAL PREFRONTAL DAMAGE INCREASES SUSCEPTIBILITY TO CONTEXTUAL EFFECTS ON DECISION-MAKING Stav Atir[1], Joseph Kable[1]; [1]University of Pennsylvania — Previous work in decision neuroscience has implicated the ventromedial prefrontal cortex (vmPFC) in encoding or comparing the subjective value of different choice options. For example, individuals with damage to this area are less consistent in their decisions and more likely to make intransitive choices. Our study extends this line of work by testing human subjects with damage to the vmPFC in an asymmetric dominance paradigm. Subjects chose between a smaller, sooner monetary reward and a larger, later monetary reward in the presence or absence of a third option. This third option was always clearly dominated by the larger, later option – it was the same on one dimension (size or delay) but worse on the other. The presence of the third option typically shifts preferences towards the targeted (dominating) option. We found that subjects with vmPFC damage were more likely to switch their preference to the larger, later reward in the presence of a dominated option compared to subjects with dorsolateral prefrontal cortex damage or to demographically-matched controls. Subjects with vmPFC damage were not more likely to switch their preference to the smaller, sooner option, suggesting that they were not changing their preferences randomly. These results suggest that, since individuals with vmPFC damage may have less strong or reliable preferences, they may rely more on easy reasons for decisions when these are available. These results also suggest that individuals with reduced function in vmPFC (e.g., drug abusers or depressed individuals) might be more susceptible to context effects such as asymmetric dominance.

B73

CORRECTION OF HIGH CONFIDENCE FALSE BELIEFS Janet Metcalfe[1], Brady Butterfield[1], Christian Habeck[1], Yaakov Stern[1]; [1]Columbia University —
Despite the intuition that strongly held beliefs are particularly difficult to change, the data on error correction indicate that general information errors that people commit with a high degree of belief are especially easy to correct. This finding is called the hypercorrection effect. The hypothesis was tested that the reason for hypercorrection stems from enhanced attention and encoding that results from a metacognitive mismatch between the person's confidence in their response and the true answer. This experiment, which is the first to use imaging to investigate the hypercorrection effect, provided support for this hypothesis, showing that both metacognitive mismatch conditions—that in which high confidence accompanies a wrong answer, and that in which low confidence accompanies a correct answer—revealed anterior cingulate and medial frontal gyrus activations. Only in the high confidence error condition, however, was an error that conflicted with the true answer mentally present. And only the high confidence error condition yielded activations in right temporal parietal junction (rTPJ) and the right dorsolateral prefrontal cortex (rDLPFC). These activations suggested that during the correction process, after error commission, people were (1) entertaining both the false belief as well as the true belief (as in theory of mind tasks which also manifest the rTPJ activation), and (2) that they were suppressing the unwanted, incorrect, information that they had, themselves, produced (as in think/no think tasks which also manifest the rDLPFC activation).



Sunday, April 1, 1:00 - 3:00 pm, Exhibit Hall

ATTENTION: Multisensory

C1

NEURONAL DIFFERENCES BETWEEN STIMULUS CONFLICT AND SUBJECTIVE PERCEPTION OF DISTRACTION IN A MULTISENSORY STROOP TASK Ulrike Zimmer[1,2], Marty Woldorff[1]; [1]Center for Cognitive Neuroscience, Duke University, [2]Cognitive Psychology & Neuroscience, Karl-Franzens University, Graz, Austria — The processing of audiovisual stimulus conflict is known to activate the anterior cingulate cortex (ACC). It also, however, appears to activate the associated sensory cortices, apparently reflecting the attentional capture by distracting input from the irrelevant stimulus modality and the need for boosted attention to the task-relevant modality (Zimmer et al., 2010, Neuroimage). It is unclear, however, how much conflict-related brain activation depends on subjects' awareness of the conflict. Here, using a modified numerical-Stroop task and fMRI, we asked how the subjective perception of multisensory conflict corresponds to the conflict-related activation in the brain. Twenty subjects were asked to detect the number of flashing dots ("two" or "three") while ignoring a matching versus non-matching spoken number. After each trial, subjects rated the degree of perceived distraction by the spoken number on a scale from one (not distracted) to four (very distracted). The relationship between the rated distraction and the conflict-related fMRI response (non-matching versus matching stimulus types) was then estimated. The results showed that conflict-related fMRI activity was found mainly in visual and auditory cortices, replicating our previous results. In addition, higher distraction rating covaried with activation magnitude in the rostral ACC and ventral-medial prefrontal cortex. Thus, the perceived distraction particularly modulated the conflict-related activation in frontal areas associated with appraisal and regulation in emotional decision making (Etkin et al., 2011,TICS). This result suggests that increased awareness of distraction may influence a subject's emotional state, which might in turn contribute to cognitive-control adjustments in response to conflicting stimulus input.

C2

AMPLITUDE-MODULATED SOUNDS ARE SYSTEMATICALLY ASSOCIATED WITH NATURAL SCENES AND INFLUENCE VISUAL SCANNING STRATEGY Aleksandra Sherman[1], Marcia Grabowecky[1,2], Satoru Suzuki[1,2]; [1]Department of Psychology, Northwestern University, Evanston, IL, [2]Interdepartmental Neuroscience Program, Northwestern University, Evanston, IL — We previously demonstrated a linear perceptual relationship between auditory amplitude-modulation (AM) rate and visual spatial-frequency using simple gratings as the visual stimuli. Here, we investigated whether this frequency-based auditory-visual association would generalize to perception of natural scenes. We found that participants consistently matched specific auditory AM rates to visual scenes from diverse categories (nature, urban, and indoor). A correlation analysis indicated that this crossmodal association was mediated by the subjective impression of density within the visual scene, with higher subjective density ratings associated with faster AM-rate matches. Furthermore, both the density ratings and AM-rate matches were relatively scale invariant suggesting that the underlying crossmodal association is between visual coding of object-based density and auditory coding of AM rate. Based on these results, we hypothesized that concurrently presented fast (7Hz) or slow (2Hz) AM-rates might influence the way in which visual attention is allocated to dense or sparse aspects within a scene. We tested this hypothesis by monitoring eye movements while participants examined each scene for a subsequent memory task. Their initial five saccades had significantly smaller amplitudes and smaller fixation durations when the faster sound was played than when the slower sound was played. This suggests that faster sounds may promote a local scene scanning strategy in which objects within a dense region are individuated, whereas slower sounds may encourage a global scanning strategy. In summary, our results suggest that auditory AM rate and visual object density are crossmodally associated, and that this association can modulate visual inspection of scenes.

C3

CROSS-MODAL, POSITIONAL, AND SEMANTIC EFFECTS IN VISUAL SLOPE PERCEPTION Stacey Parrott[1], Emmanuel Guzman-Martinez[1], Laura Ortega[1], Marcia Grabowecky[1], Satoru Suzuki[1]; [1]Northwestern University — Extracting slopes from arrays of visual features is relevant to perceiving terrains and interpreting graphs. To understand slope perception in a broader context, we investigated the effects of sounds, position, and semantic priming on a visual search task in which observers searched for a graph that displayed a specific slope. Four bar graphs or scatter plots were simultaneously presented in separate quadrants. The task was to press the space bar as quickly as possible if one of the graphs displayed a specific (positive or negative) slope and to refrain from response otherwise. Concurrently presented ascending (or descending) pitch slowed responses to the positive-slope (or negative-slope) targets, indicating crossmodal interference. Positive slopes were rapidly detected in the upper-right quadrant but slowly detected in the upper-left quadrant whereas negative slopes were rapidly detected in the upper-left quadrant but slowly detected in the upper-right quadrant, indicating position dependence. Finally, positive slopes were detected faster when the search display was immediately preceded by a briefly flashed word "uphill" than "downhill" and vice versa for detecting a negative slope, indicating a semantic priming effect. This priming effect is unlikely due to reminding observers of the target because the target type (defined as positive and negative slopes) was blocked, and the semantic priming only affected the perception of scatter plots (not bar graphs). In summary, perception of visual slope is systematically influenced by auditory signals, placement of graphs, and semantic priming, suggesting that graph perception can be improved by appropriate manipulations of contextual information.

C4

BRAIN MECHANISMS OF COGNITIVE DISTRACTION WHILE DRIVING Richard Young[1], Li Hsieh[1], Sean Seaman[1]; [1]Wayne State University — Goals and Methods: Review brain mechanisms underlying response delays to

visual events while performing visual-manual and cell phone secondary tasks while driving. Associate these mechanisms with the orienting attention network in the brain. Results: Detecting and responding to on-road events during secondary visual-manual tasks constitutes a second orthogonal "cognitive distraction" dimension, independent of eye movements to secondary in-vehicle tasks (1). The right superior parietal lobe is the primary brain site associated with the delay in foot pedal response times to an intermittent red light during hands-free cellular conversations during a driving-like scenario (2). It is also a key site in the orienting attention network (3). Conclusion: The effect of cognitive distraction from secondary tasks on event detection while driving is associated with the orienting attentional network, particularly with neural mechanisms in the right superior parietal lobe. This approach may lead to understanding cognitive distraction while driving in terms of attention networks and well-established experimental paradigms in cognitive neuroscience, hopefully leading to new and effective countermeasures to reduce crashes and improve driving safety. (1) Young, R.A. & Angell, L.S. (2003). The dimensions of driver performance during secondary manual tasks. Driving Assessment 2003, Park City, Utah. (2) Bowyer, S.M., Hsieh, L., Moran, J.E., Young, R.A., et al., (2009). Conversation effects on neural mechanisms underlying reaction time to visual events while viewing a driving scene using MEG. Brain Research, 1251, 151-161. (3) Posner, M.I. & Petersen, S.E. (1990). The attention system of the human brain. Annual Review of Neuroscience, 13, 25-42.

C5

BEHAVIORAL FACILITATION AND INTERFERENCE EFFECTS WHILE HOLDING A PAIR OF SPEAKERS DURING AN AUDITORY DISCRIMINATION TASK Stephanie Simon-Dack[1], Shannon Doody[1], Kathleen Burkhart[1], Kelly Fogle[1], Brittney Klauser[1], Lindsay Marsh[1], Sam Godsey[1], Derek Gosman[1], Grant Sinning[1]; [1]Ball State University — This study addresses the conditions under which behavioral facilitation or interference is observed for an auditory oddball task when participants are touching the sound source in comparison to having no physical contact. Participants performed a difficult target discrimination task by detecting when a rare deviant "oddball" sound was emitted from an attended speaker while ignoring frequently occurring standard sounds. Participants ran in two sessions each and were randomly divided into two possible conditions. In condition 1 (Lap, Lap), participants kept their hands in their laps for both sessions. In condition 2 (Lap, Hold), participants kept their hands in their laps for session one and held the speakers for session two. Reaction time (RT) and accuracy differences between the sessions were compared across groups. Participants were also given the Barkley and Murphy Current Symptoms Scale - Self Report Form for ADHD (1998) and were compared on the basis of whether they qualified as having attention deficit symptomatology. Current results suggest that participants with attention deficits demonstrate speeded RT differences between the sessions for condition 1, while they demonstrate slowed RT differences between the sessions for condition 2. In contrast, participants who do not show ADHD symptomatology demonstrate no change between the sessions for condition 1 and speeded RTs between the sessions for condition 2. Overall, individuals are faster when holding a set of speakers than when resting their hands in their laps. However, individuals with ADHD symptomatology show an opposite effect, such that holding the speakers may cause behavioral interference.

C6

ATTENTIONAL MODULATION OF SENSORY PROCESSING: AN FMRI STUDY Erica Sieg[1], Yangfeifei Gao[2], Barrett Kern[3], John Sweeney[4], Sarah Keedy[2]; [1]The Chicago School Of Professional Psychology, [2]University of Illinois at Chicago, [3]Roosevelt University, [4]University of Texas Southwestern Medical Center — Attention systems in the brain play a top-down modulatory role affecting how sensory cortices respond to stimuli. Understanding such mechanisms may be clinically important, as uncontrolled processing of context-irrelevant sensory stimuli is a common feature of neuropsychiatric disorders and may contribute to multiple abnormalities. Studies have not been conducted which examine how parametric modulation of attentional demand affects processing of task-irrelevant information both within-mode (irrelevant visual information during a visual task) and cross-mode (irrelevant auditory information during a visual task). To test the hypotheses that increasing attentional demand diminishes cortical response to irrelevant sensory information, fMRI studies were conducted with healthy subjects performing a visual attention task with varying levels of difficulty (an X-CPT with visually degraded letters). While the task was performed, irrelevant stimuli were added: either visual motion was added to the periphery of the visual field or pure tones were played binaurally. As predicted, increased difficulty of the primary task was associated with reduced cortical response to irrelevant visual motion in area MT (medial temporal area) to the irrelevant motion. However, auditory cortex did not show modulated response to the irrelevant sounds as the primary task difficulty increased. These data provide insight into top-down regulation of basic sensory processing and suggest a need for further exploration of within- and cross-modal effects.

C7

PERCEPTUAL LOAD INFLUENCES PERCEPTION AND INHIBITION OF RETURN IN TOUCH. EVIDENCE FROM ERPS AND BEHAVIOUR Alexander Jones[1], Bettina Forster[1]; [1]City University London — The perceptual load theory of attention suggests increased load in a central task decreases the ability for irrelevant peripheral stimuli to capture our attention. Participants viewed a rapid serial visual presentation stream (RSVP) of letters on a central monitor. During the presentation of letters participants received a lateralized tactile exogenous cue to the left or right hand. In a single task participants responded to a tactile target to the same or opposite hand as the cue (low perceptual load). In a dual task, participants searched the RSVP stream for a number and responded also to this visual target (high perceptual load). Behavioural results demonstrated tactile inhibition of return (IOR) in the single whilst no exogenous attention effect in the dual task. ERPs immediately following the cue (cue-locked ERPs) demonstrated increased perceptual load resulting in decreased somatosensory processing at the P100. ERP analysis of attentional control processes (cue-target interval) demonstrated an ADAN in both tasks. The ADAN was significantly larger in the single compared to the dual task. That is, increased perceptual load led to a decreased ADAN. Analysis of post-target ERPs demonstrated earlier attention modulations (N80) when perceptual load was low compared to high. Taken together, this study demonstrates, through several analyses (behavioural and ERP), that increased visual perceptual load resulted in decreased processing of irrelevant tactile stimuli.

EMOTION & SOCIAL: Emotion-cognition interactions

C8

ANXIETY AND THE PERCEPTION OF SMALL QUANTITIES Adi Dayan[1], Andrea Berger[1]; [1]Ben Gurion University, Israel — The goal of this research was to examine the relationship between the ability for number perception in the subitizing range (quantities 1-4) and levels of trait anxiety, with perceptual sensitivity serving as a possible mediator. These factors are hypothesized to be linked by a common adaptive advantage used by animals and human infants. A dis-habituation task was used, in which a slide, with a fixed number of schematic faces (angry and neutral), is presented repeatedly (habituation phase), at the end of which a slide with a different quantity is shown (dis-habituation phase). Participants then become habituated to the new quantity and so forth. Trait anxiety was evaluated using the State-Trait Anxiety Questionnaire (Spielberger, 1984), and perceptual sensitivity was evaluated using Adult Temperament Questionnaire (Evans & Rothbart, 2007). ERP amplitudes along with reaction times for key pressing at the appearance of a new quantity were measured. Results show high correlation between anxiety and perceptual sensitivity as well as high fit indices for a mediation model. It

further seems that angry stimuli, compared to neutral stimuli, evoke smaller amplitudes in right parietal scalp localization (related in literature to quantity perception). Furthermore, participants higher in trait anxiety and perceptual sensitivity showed smaller amplitudes, and faster reaction times. It is plausible to conclude that both trait and state anxiety allow for the advantage of less cognitive effort when dealing with small quantities. Research implications may include an implicit measure of trait anxiety using a quantitative task, and future research will focus on young children.

C9

PUSHING FEAR ASIDE: NEURAL REGIONS INVOLVED IN IGNORING IRRELEVANT FEAR EXPRESSIONS. Erik C. Nook[1], Ajay B. Satpute[1], Sandhya Narayanan[1], Jochen Weber[1], Kevin N. Ochsner[1]; [1]Columbia University in the City of New York — While at times affective signals in the environment can be our ally, in other situations they can interfere with what is required to be done. Here, cognitive control is required to attend to goal-relevant information and to ignore the more salient affective information. Current neurocognitive models underlying the cognitive control of emotion posit that prefrontal regions downregulate regions involved in processing affective information to facilitate goal-directed behaviors. We investigated this neurocircuitry further by using a parametric design, addressing the question of how this network responds as affective information becomes increasingly more salient. Twenty participants were scanned while they viewed faces that were morphed to vary in affective intensity (five levels, from calm to fearful), and to range on a non-affective perceptual dimension (five levels, from centered to tilted). In a within-subject design, participants judged either the amount of affect or tilt of faces. Even though the fearfulness of the expression was irrelevant to judging the tilt, participants took longer to judge the tilt as the fearfulness of the face increased, suggesting that affectively salient information interfered with task goals. Tracking these behavioral effects, neuroimaging results showed that increasing fearfulness while judging tilt elicited activation of the prefrontal cortex and deactivation of the insula. These results support current themes in the field suggesting that affect signals in the environment are salient and may interfere with ongoing task goals, and that dealing with this interference may rely on prefrontal regions to down-regulate the response in affective sensitive regions, such as the insula.

C10

OXYTOCIN INCREASES EMPATHY FOR VICTIMS OF CRIMINAL OFFENSES Lara Moody[1], Raja Parasuraman[1], Peter Twieg[1], Ewart de Visser[1], Kevin McCabe[1], Martin O'Hara[2], Mary Lee[3], Frank Krueger[1]; [1]George Mason University, Fairfax, VA, [2]Virginia Hospital Center, Fairfax Hospital, Falls Church, VA, [3]National Institute on Drug Abuse, Baltimore, MD — The neuropetide oxytocin functions both as a hormone and neurotransmitter and facilitates prosocial affiliative and approach behavior. Given that empathy (i.e., capacity to share and understand the feelings of others) is an essential mental state for approach related affective behavior, we hypothesized that oxytocin promotes empathy for victims of criminal offenses. Healthy males received either intranasal oxytocin or placebo in a randomized, double-blind, placebo-controlled, between-subject design. Fifty-four male participants were given a set of legal vignettes that described an event during which an offender engaged in criminal offenses against fictional victims. As an unaffected third-party, participants were asked to rate those criminal offenses on the degree to which the offender deserved punishment and how much harm was inflicted on the victim. Exogenous administration of oxytocin selectively increased empathy for the victim but not for the perpetrators of criminal offenses leading to higher harm ratings for the victim. We propose that oxytocin promotes prosocial affiliative and approach behavior regarding the interpersonal relationship between an unaffected third-party and fictional characters in the criminal scenarios, which in turn increased empathic concern for the victim but not for the offender. Given the selective effect found in this study, future research should explore the context- and person-dependent nature of exogenous oxytocin administration in individuals with antisocial personality disorders, which are far more common among males. One strategic therapeutic approach might be the combination of oxytocin pharmacotherapy with a psychosocial intervention design to target specific cognitive outcomes that improve victim empathy.

C11

POST-ERROR ALPHA SUPPRESSION PREDICTS ANHEDONIC DEPRESSION AND REDUCED DAILY REPORTS OF POSITIVE EMOTION AND ACTIVE COPING Rebecca Compton[1], Julia Hofheimer[1], Rebecca Kazinka[1], Amanda Levinson[1], Amanda Zheutlin[1]; [1]Haverford College — This study predicted that changes in neural activity following performance errors are associated with depression and can predict daily affect and coping. Sixty-two participants, including 24 scoring high on the CESD self-report measure of depression, completed a 6-choice Stroop task while EEG was recorded, and subsequently completed daily self-reports of stressors, affect, and coping behaviors. EEG alpha power was significantly reduced in the 1-sec period following mistakes compared to correct responses, indicating increased cortical arousal following errors (main effect of accuracy, $p < .0001$). Error-related alpha suppression in the frontal region was more pronounced in depressed versus non-depressed participants (accuracy x site x group, $p < .05$). Greater error-related alpha suppression in both frontal and parietal regions predicted lower positive affect throughout the subsequent daily reporting period ($rs = -0.30$ and -0.28, $ps < .05$). Furthermore, greater frontal alpha suppression following errors on incongruent Stroop trials predicted higher levels of anhedonic depression at the time of the lab session (MASQ-AD; $r = 0.26$, $p < .05$) as well as reduced use of task-focused coping ($r = -0.28$, $p < .05$) and approach-focused coping ($r = -0.31$, $p < .05$) in the daily reporting period. Alpha suppression was not related to negative affect or emotion-focused coping, although these were highly correlated with depression. In sum, cortical arousal following performance errors was associated with anhedonia and low levels of active, adaptive coping strategies. Results imply that the anhedonic aspect of depression may be especially associated with maladaptive responses to failure.

C12

INDIVIDUAL DIFFERENCES IN FRONTOPARIETAL ACTIVITY AND CONNECTIVITY PREDICT HIGH-STAKES CHOKING Andrew Mattarella-Micke[1], Sian Beilock[1]; [1]University of Chicago — In high-stakes tests, pressure to succeed can cause students to perform below their ability (or "choke under pressure") instead. Distraction theories propose that choking is caused by a disruption of working memory (WM). Distraction theories thus predict that individuals who choke the most should exhibit characteristic differences in the functioning of their WM systems under stress, relative to those who are not impacted by pressure. Using functional MRI, we explored the hypothesis that online disturbances of WM might predict high-stakes choking. Participants completed math problems before (low-pressure) and after (high-pressure) introduction of a high-stakes situation during fMRI acquisition. Math problems were selected to place either high or low demands on WM. As a result of the high-stakes situation, performance of high WM-demand problem accuracy significantly dropped from low (M=0.71,SE=.02) to high-pressure (M=0.61,SE=03) situations [t(12)=3.78, p=.003], while low demand accuracy did not (Low-pressure: M=0.87,SE=.03; High-pressure: M=0.89,SE=.02) [t(12)=0.67,p=.52,ns]. Low- and high-demand problem activity was contrasted to localize WM-related regions. Within the resulting network, activity during high-demand problems in the intraparietal sulcus (IPS) and the inferior frontal junction (IFJ) predicted individual differences in choking. The more an individual choked, the less activity exhibited in these regions during high-pressure math problem performance. Connectivity analyses revealed a subset of WM-related regions that decouple from the IPS and the IFJ under pressure. Individual differences in degree of decoupling predicted further variance in choking. These results shed light on how high-stakes situations compro-

mise performance and why some people are more prone to performance loss than others.

C13

HOW EMOTIONAL STATE AFFECTS EMPATHY FOR PAIN—AN ERP STUDY Rui Sun[1], Shihui Han[1]; [1]Peking University — Social and developmental psychology research have found that individuals' emotion can affect empathy. However, different research have reached different conclusions, and few research have directly explored the relationship between the two using neuroimaging methods. The current study used the high time-resolution event-related potentials (ERPs), and used movie clips to prime subjects into happy, neutral and sad emotions aimed at directly studying the relationship between emotion and empathy. Subjects were instructed to judge the expressions they saw to be painful or neutral. Results showed that during 80-110ms, in happy emotion, painful faces triggered a larger N1 compared to neutral faces, while there's no difference between painful and neutral faces in neutral and sad emotions. During 300-400ms, in happy emotion, the difference between painful and neutral emotions decreased but in sad and neutral emotions, there were still difference between two expressions. The results proved our previous early and late model of empathy for pain, suggesting that emotional states can dynamically affect empathy for pain in both early automatic emotion sharing stage and late cognitive appraisal stage. It also indicated that happy emotion would increase the ability to detect painful expression in the early stage but would decrease empathy for pain in the late cognitive appraisal stage; sad emotion could not increase the detection of painful expression in the early stage but would last longer in the late stage.

C14

THE INFLUENCE OF SPATIAL FREQUENCY INFORMATION FOR THE PROCESSING OF IAPS PICTURES Liane I Schoenwald[1], Matthias M Mueller[1]; [1]Institute of Psychology, University of Leipzig, Germany — We examined to what extent the spatial frequency of an emotional picture has an influence on their processing. Recent research showed that low spatial frequency (LSF) information in pictures of emotional faces is processed by a fast pathway to the amygdala and elicited higher amygdala activation for these faces. However, less is known about the influence of LSF information in pictures from the International Affective Picture System (IAPS). Therefore, we presented unpleasant and neutral pictures with broadband spatial frequency (BSF), only with high spatial frequency (HSF) or only with low spatial frequency (LSF). Subjects had to view pictures and rated valence and arousal afterwards. During this procedure EEG was recorded. As index for emotional processing we analyzed the Early Posterior Negativity (EPN) and the Late Positive Potential (LPP). In line with previous research, emotional BSF pictures elicited a greater negativity on posterior electrodes from 170 to 290 ms and a greater positivity on central-parietal electrodes from 400 to 1000 ms compared to neutral pictures. In contrast, HSF pictures as well as LSF pictures triggered later and shorter differences (for HSF from 230 to 290 ms and for LSF from 260 to 320 ms) between emotional and neutral pictures in the EPN. Furthermore, only the HSF pictures, but not the LSF pictures, were further processed as indexed by the LPP.

C15

INEQUITY AVERSION AS AN ABSTRACT RULE IN THE ULTIMATUM GAME: AN FMRI STUDY. Claudia Civai[1], Cristiano Crescentini[1,2], Aldo Rustichini[3], Raffaella Ida Rumiati[1]; [1]SISSA, Trieste, Italy, [2]Azienda Ospedaliero-Universitaria Santa Maria della Misericordia, Udine, Italy, [3]University of Minnesota — Neuroscientific findings support the idea that emotional reactions to unfairness cause the non-utilitarian, and irrational, rejections in the Ultimatum Game (Sanfey et al, 2003). However, not only emotions should be accounted for triggering rejections (Civai et al., 2010). Here, we aim at understanding the role played by the perception of equity and its neural basis. In the task, the participant has to accept or reject monetary divisions, randomly established by a device, between two couples of players: a) the participant and another person (myself –MS- condition); b) two uninvolved third parties (third party –TP- condition). In both conditions, players are not responsible for the outcome, but they are all affected by participant's decision. Behavioral results indicate that unequal outcomes in TP are rejected significantly more than equal and MS unequal advantageous, but not MS unequal disadvantageous, outcomes. Analysis of BOLD signal shows, on the one hand, a higher activation of the anterior part of the medial prefrontal cortex (MPFC) in MS for disadvantageous outcomes, as opposed to equal and advantageous outcomes, that is likely to reflect the negative affective reaction to disadvantageous inequity, that affects the self; on the other hand, a higher activation of anterior insula (AI) for unequal outcome, irrespectively of the target, reflects a sensitivity to inequity. Our interpretation is that equity is perceived as a basic social norm, and its violation is signaled by the activation of AI (King-Casas et al., 2008), whereas MPFC is related to the frustration elicited by a disadvantageous outcome.

C16

GOAL-DIRECTED BEHAVIOR UNDER EMOTIONAL DISTRACTION: COMPENSATORY HYPER-ACTIVATION IN TASK-SPECIFIC BRAIN REGIONS Philipp Kanske[1,2], Janine Heissler[1], Sandra Schönfelder[1], Michèle Wessa[2]; [1]Central Institute of Mental Health, Mannheim, Germany, [2]University Hospital Heidelberg, Germany — Despite the distracting effects of emotional stimuli on concurrent task performance, humans are able to uphold goal-directed behavior. Here, we investigated the hypotheses (1) that this effect is due to the increased recruitment of task-specific neural resources and (2) that individuals with heightened emotional reactivity show a more pronounced compensatory hyperactivation. In a two-step functional magnetic resonance imaging study we first localized those areas involved in mental arithmetics by contrasting arithmetic problems with a number detection task. The resulting activation maps were then used as masks in a second experiment that compared the effects of neutral and emotional distracter images on mental arithmetics. We found increased response times in the emotional distracter condition, accompanied by increased activation in task-specific areas, including superior parietal cortex, dorsolateral and dorsomedial prefrontal cortex. This activation increase correlated with larger behavioral impairment through emotional distraction. Similar error rates in both conditions indicated that cognitive task performance is preserved through increased recruitment of task-specific neural resources when emotional distracter stimuli are present. We also tested a group of patients with bipolar disorder, who are particularly sensitive to the emotional content of stimuli. Even though they were also able to perform the arithmetic task, they showed a stronger increase in compensatory task-related activation than matched healthy controls. The data show that neural efficiency during task processing is decreased through emotional distracters, an effect that is particularly pronounced in individuals with heightened emotional reactivity.

C17

SEX INFLUENCES THE ROLE OF THE AMYGDALA IN MEMORY FOR POSITIVE AND NEGATIVE STIMULI Jennifer Strafford Stevens[1], Janice M. Hassett[1], Stephan Hamann[1]; [1]Emory University — The amygdala enhances subsequent episodic memory for emotional stimuli via modulation of hippocampal/parahippocampal activity. Previous studies have reported a sex-related hemispheric asymmetry, with this effect observed for the left amygdala in women but the right amygdala in men. However, prior studies examined only negative emotional stimuli. It is not known whether a similar effect extends to positive emotional stimuli. Here we investigated this question, and for the first time examined whether sex differences exist in amygdala-hippocampal interactions previously linked to the emotional enhancement of episodic memory. Women and men viewed emotionally positive, negative, and neutral pictures during event-related fMRI. Subsequent cued recall for positive and negative pictures was enhanced vs. neutral pictures, with similar memory effects in women and men. Women showed greater subsequent-memory-related activation than men for negative vs. neutral stimuli in the left amygdala. In the corresponding analysis for positive stimuli, women showed

greater memory-related activation in the right amygdala and at a lower statistical threshold, the left amygdala. Women, but not men, showed greater functional connectivity related to subsequent memory for positive stimuli between the left and right amygdala and the contralateral hippocampus. Findings suggest that previously observed sex-related hemispheric asymmetries differ according to positive or negative emotional valence of stimuli, and that functional connectivity related to subsequent memory for emotional stimuli differs by sex. Results highlight how emotional memory encoding recruits different brain regions and networks in women and men, differences that may relate to behavioral sex differences in emotional memory.

EMOTION & SOCIAL: Emotional responding

C18

LESIONED BRAIN REGIONS CORRELATING WITH ANXIETY IN VIETNAM VETERANS Kris Knutson[1], Shana Rakowsky[4], Jeffrey Solomon[1,2], Frank Krueger[1,6], Vanessa Raymont[3,7], Eric Wassermann[1], Jordan Grafman[1,5]; [1]National Institute of Neurological Disorders and Stroke, National Institutes of Health, [2]Medical Numerics, Inc., Germantown, Maryland, [3]Imperial College London, [4]Georgetown University, [5]Kessler Foundation Research Center, West Orange, New Jersey, [6]George Mason University, Fairfax, VA, [7]Johns Hopkins University — Anxiety negatively affects quality of life and psychosocial functioning. Previous research has shown anxiety in healthy volunteers to be related to variation in the volume of brain regions such as the amygdala, hippocampus, and the bed nucleus of the stria terminalis. Evidence based on the lateralization of lesions suggests that the hemisphere affected also modulates levels of anxiety. We studied a unique sample of Vietnam War veterans with penetrating traumatic brain injuries (TBI), and found that lesions in limbic and cortical structures in the left hemisphere were associated with increased anxiety as measured by the Neurobehavioral Rating Scale, a clinician rating which helps define the impact of brain injury and an important source of information about a patient's everyday behavior after TBI.

C19

RESTING VAGAL REGULATION PREDICTS SYMPATHETIC AND TESTOSTERONE RESPONSES TO OBSERVED VIOLENCE Eric Porges[1], Karen Smith[1], Jean Decety[1]; [1]University of Chicago — Viewing videos of violent content has been hypothesized to increase antisocial behaviors including interpersonal violence. Previous research evaluating the impact of observing violence on the autonomic nervous system has focused on measures that reflect changes in states of arousal as indexed by the sympathetic nervous system. Measurement of the self-regulatory calming influences of the parasympathetic nervous system has been neglected, although reduced parasympathetic activity, as indexed by respiratory sinus arrhythmia (RSA), has been shown to facilitate antisocial behavior. Consistent with a hierarchical model of the autonomic nervous system (i.e., Polyvagal Theory), individual differences in parasympathetic nervous system activity reflected in RSA were hypothesized to have an inhibitory impact on sympathetic and hormonal reactivity while observing violence. Autonomic data (i.e., electrodermal activity (EDA), heart rate and RSA) were collected from forty adult males prior to and while viewing either a violent sporting event or a non-arousing documentary. In addition, pre- and post-video saliva samples were collected for analysis of cortisol and testosterone changes. Participants who viewed the violent video exhibited significantly increased EDA and heart rate relative to participants who viewed the documentary. There were no significant differences in RSA in response to the stimuli, suggesting that while viewing violence increases sympathetic activity it does not elicit parasympathetic withdrawal. However, within the group viewing violence, only those with lower levels of resting RSA demonstrated an increase in salivary testosterone. This suggests that high resting parasympathetic activity protects against increased reactivity and antisocial behavior after viewing violent content.

LONG-TERM MEMORY: Episodic

C20

THE EFFECT OF VALENCE AND AROUSAL ON ASSOCIATIVE WORKING MEMORY AND LONG-TERM MEMORY Heiko Bergmann[1], Christien Marsman[1], Mark Rijpkema[1,2], Guillén Fernández[1,2], Roy P.C. Kessels[1,3]; [1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, [2]Radboud University Nijmegen Medical Centre, Department for Cognitive Neuroscience, [3]Radboud University Nijmegen Medical Centre, Department of Medical Psychology — Emotional content typically facilitates subsequent memory, known as the emotional enhancement effect. However, the differential effects of valence and arousal on associative working memory (WM) and long-term memory (LTM) have been scarcely studied. To fill this gap, we conducted a five-pair associative delayed-match-to-sample (DMS) task and an unexpected subsequent recognition memory (LTM) task for both single items and binding. The encoding phase of the DMS task consisted of five picture pairs, each containing one emotionally-neutral picture and one emotional IAPS picture. Valence (positive, neutral, negative) and arousal (high, low) of the emotional stimulus were manipulated across trials. This was followed by a 10s-delay and a probe phase in which five pairs were tested. Participants had to indicate for each pair whether it matched one of the presented ones. In the subsequent LTM task we first presented one emotional picture, being either an old or new stimulus. In the former, this was followed by the presentation of the same emotional picture together with one neutral picture, which was also shown during the first task but not necessarily together. The results for both the associative WM and LTM task, where we corrected for WM performance, showed an arousal effect: picture pairs containing low-arousal pictures were better remembered than high-arousal pairs. For the single-item LTM task we obtained a valence effect: negative stimuli were better remembered than positive stimuli. Arousing stimuli might attract attention and therefore the processing of associations consisting of arousing elements may be disrupted, affecting both WM and LTM performance.

EMOTION & SOCIAL: Emotional responding

C21

ERP STUDY ON CATEGORICAL PERCEPTION OF HAPPINESS AND FEAR FACIAL EXPRESSIONS Shih-Tseng Tina Huang[1], Ming Chun Lee[1], Bethany C. Y. Wu[2]; [1]National Chung-Cheng University,Taiwan, [2]National Cheng-Chi University, Taiwan — The present study investigates differences between judging between-category facial expressions and judging within-category facial expressions, using ERP measures. Pairs of happy and fearful faces were morphed into a continuum of happy-fearful expressions in 100 steps. In each trial, two morphed faces were presented in sequence. In the same condition, the two faces were identical to each other. In the between-category condition, the two faces were on the two sides of the continuum midpoint, and were always 30% apart (e.g., 40% vs. 70%). Finally, in the within-category condition, the two faces were also 30% apart but on the same side of morphed continuum (e.g., 8% vs. 38%). There were altogether 288 trials, including 144 same pairs, 72 between-category pairs, and 72 within-category pairs. A trial began with a cross for fixation presented for 400 ms, followed by a pair of faces presented in sequence. Each face was shown for 400 ms, with a 1300-ms blank in between. The second face was followed by a response period of 1200 ms, and then an ISI of 1500 ms. Peak amplitudes of P120, N170 at PO8, and mean amplitude of P300 at Fz, Cz, Pz were analyzed. Results showed that the peak amplitudes of P120 and N170 of the second face were greater than those of the first face at PO8. Furthermore, P3 at both Cz and Pz were higher in the between-category condition than those in the

same and within-category conditions, suggesting an advantage judging facial expression between categories than within a category.

C22

STRIATAL FMRI RESPONSES TO TRANSIENT EVENTS DURING PLAYING VERSUS VIEWING A VIDEO GAME Jari Kätsyri[1], Lauri Nummenmaa[2,3], Riitta Hari[2,4], Niklas Ravaja[1,5]; [1]Aalto University School of Economics, Helsinki, Finland, [2]Aalto University School of Science, Espoo, Finland, [3]Turku PET Centre, Finland, [4]Advanced Magnetic Resonance Imaging Centre, Espoo, Finland, [5]University of Helsinki, Finland — Although video game playing elicits tonic striatal activation in the brain's reward circuitry, striatal reward responses to transient video-game events remain poorly known. The present functional magnetic resonance imaging (fMRI) study compared striatal responses to rewarding (winning), aversive (losing), and neutral (starting a new game round) game events during video game playing and passive viewing of game play. Eleven healthy adults both played and watched a game play video recorded from a competitive first-person tank shooter game during fMRI at 3 T. Event-related statistical parametric mapping, based on automatic annotation of the game events, was followed by region-of-interest analyses in six anatomically defined striatal regions. Activation was weaker to aversive than neutral events in all other regions except the sensorimotor posterior putamen. Furthermore, the suppression of activity due to losing was more pronounced during playing than viewing. We suggest that this loss-related striatal suppression reflects aversion that is stronger during active video-game playing than passive viewing. No region displayed stronger activation during rewarding than neutral events; on the contrary, activation in anterior putamen was suppressed also during winning in both conditions, and activation in ventral caudate was suppressed during winning in the active playing condition. Consistently with our findings, also Mathiak et al. (BMC Neurosci 2011) found weaker striatal responses to winning compared with playing in general. A possible explanation could be that striatal activation remained so elevated throughout the game that additional increases could not be detected by our methods.

ATTENTION: Auditory

C23

VISUAL INPUT AIDS SELECTIVE SPEECH TRACKING AT A "COCKTAIL PARTY" Elana Zion Golumbic[1,2], Gregory Cogan[3], Morgan Harvey[2], Charles Schroeder[1,2], David Poeppel[3]; [1]Columbia University, [2]Nathan Kline Institute for Psychiatric Research, [3]New York University — Our ability to attend to a particular conversation amidst competing input streams (e.g. other speakers), epitomized by the "cocktail party" problem, is remarkable. One neuronal mechanism proposed for achieving this feat is synchronization of low-frequency neural activity in auditory cortex (1-7Hz) to the temporal envelope of the attended stream ('selective speech tracking'). Top-down attention may also aid this tracking by predicting upcoming temporal events in the stream. How these two mechanisms are integrated and consequently, how attended speech is selectively tracked, remains unresolved. We investigated whether congruent visual input of the attended speaker contributes to selective speech tracking in auditory cortex. Since lip and head movements during speech are highly correlated with the temporal envelope of speech, but precede them by ~150 ms, visual input provides excellent predictive cues for the timing of upcoming acoustics. We presented natural speech to participants while recording neuromagnetic activity. Speech segments were presented alone (single speaker) or concurrently with another speech segment (cocktail party). In addition, audio was either presented alone (A) or accompanied by a video of the speaker (AV). In the Single Speaker condition we found selective low-frequency speech tracking in both AV and A conditions. However, in the Cocktail Party condition selective speech tracking was only found when visual input was provided, but not when listening to a 'cocktail party of voices'. These results suggest that under perceptually challenging situations such as the 'cocktail party', visual input plays a key role in focusing attention and directly influences activity in auditory cortex.

EMOTION & SOCIAL: Emotional responding

C24

SPECIFIC AND GENERAL PAVLOVIAN-TO-INSTRUMENTAL TRANSFER IN AN AVOIDANCE LEARNING TASK Andrea H. Lewis[1], Michael A. Niznikiewicz[2], Natasha Nadler[3], Andrew R. Delamater[3], Mauricio R. Delgado[1]; [1]Rutgers University - Newark, [2]University of Illinois at Urbana-Champaign, [3]Brooklyn College - City University of New York — Pavlovian-to-instrumental transfer (PIT) is a procedure that probes the influence of Pavlovian cues over instrumental responding. A long-standing model of animal learning, PIT and its underlying neural basis have recently been extended to investigation in humans. The current study examined both specific and general PIT in a simple avoidance learning paradigm using fMRI. In the instrumental phase, associations between instrumental responses (R1 and R2) and the avoidance of aversive outcomes (O1 and O2) were acquired. In the Pavlovian phase, five stimulus-outcome pairings were presented, such that each visual stimulus (S1-S5) was paired with either one of the previously viewed aversive outcomes (O1 and O2), a novel aversive outcome (O3), or one of two different neutral outcomes (O4 and O5). The transfer phase involved separate presentation of the five visual stimuli in the absence of reinforcement. During this phase, subjects were instructed to respond whenever they saw fit in order to avoid the aversive outcomes. Behavioral results exhibited a selective increase in responses to S1 and S2 when both the stimulus and response shared a learned Pavlovian outcome. Additionally, a general transfer effect was observed such that the stimulus (S3) associated with the novel aversive outcome (O3) elicited a nonselective increase in both available responses (R1 and R2) as compared to the two neutral stimuli. Initial analysis of BOLD data (n=10) suggests a correlation between both specific and general PIT and increases in striatal activation. Further analyses will probe differential activation in corticostriatal circuitry for specific and general forms of PIT.

C26

CARDIAC VAGAL CONTROL AND CULTURAL BACKGROUND CONTRIBUTE TO BEHAVIORAL REACTIVITY AND DIFFERENT PHASES OF HEART RATE RESPONSE DURING COMPASSION FOR PHYSICAL PAIN Xiao-Fei Yang[1,2], Mary Helen Immordino-Yang[1,2,3]; [1]Brain and Creativity Institute, University of Southern California, [2]Neuroscience Graduate Program, University of Southern California, [3]Rossier School of Education, University of Southern California — Both cardiac vagal control (CVC) and cultural background are known to modulate people's emotional responses. For example, higher CVC has been linked with less negative emotional expression (Pu, et al., 2010); and members of the Chinese culture have been described to value emotion moderation (Russell & Yik, 1996), and to experience emotions with lower frequency, intensity and duration (Bond, 1993). However, it is unclear how these two factors together influence emotional behavior and the heart rate (HR) responses that may underlie it. We investigated participants' emotional responses during compassion for physical pain (Immordino-Yang, 2009) in three cultural groups, Chinese, Asian American and non-Asian American. Participants first viewed video-clips depicting another person's painful physical injury during a one-on-one naturalistic interview session. Independent coders rated participants' behavioral reactivity during the videotaped interviews. Later, participants viewed brief reminders of the video-clips (stimulus processing phase, SPP), followed by periods of black-screen for reflection/deliberation (reflection/deliberation phase, RDP). Participants' HR responses during SPP and RDP were measured with electrocardiogram (ECG). Baseline ECG recordings were also taken to establish measures for CVC. We found that: 1) Behavioral reactivity correlated with the peak HR acceleration during SPP. 2) CVC and culture indepen-

dently predicted behavioral reactivity. 3) CVC predicted the range of HR change during SPP, whereas culture affected the peak HR acceleration during RDP. Taken together, our findings suggest that CVC and culture are independently associated with people's emotional responses, with CVC influencing the initial SPP, and culture influencing the later RDP.

C27

HEART RATE VARIABILITY DISTINGUISHES BETWEEN OBSERVATION OF PLEASANT AND PAINFUL CONDITIONS Adrienne Moore[1], Andrea Chiba[1]; [1]University of California, San Diego -- Cognitive Science Dept. — The goal of this study was to test the hypothesis that empathy for the physical discomfort of others involves a simulation of the other's autonomic response to the discomfort. Pairs of female participants were recruited to observe one another inserting the left hand into ice water (a cold pressor pain task) and warm water for short intervals. EKG heart rates were collected from one participant per pair, both during the experience of (self condition) and the observation of (empathy condition) the hand immersion in water baths of comfortable (warm) and uncomfortable/painful (cold) temperatures. A wavelet based time-frequency analysis was used to quantify heart rate variability in frequency bands indicating the distinct contributions from the parasympathetic and sympathetic branches of the autonomic nervous system to heart rate. Statistically significant differences in parasympathetic driven heart rate variability were found when the empathy cold/painful condition was compared to the empathy warm/pleasant condition. This finding is consistent with an "embodied cognition" view of empathy as involving a set of bodily responses associated with emotion which are referred to another. However, heart rate variability was not found to differ in the same way in the cold/warm empathy conditions as in the cold/warm self conditions. So this study does not confirm an "embodied simulation" account of empathy expressed through heart rate, which would predict that the empathy conditions would mimic the self conditions. Relationships between visual analog scale ratings of the pleasant and painful experiences, trait empathy, and HRV responses will be discussed as well.

EMOTION & SOCIAL: Other

C28

SELECTIVITY AND MULTIFUNCTIONALITY IN THE STS Ben Deen[1], Kami Koldewyn[1], Sarah Weigelt[1], Nancy Kanwisher[1], Rebecca Saxe[1]; [1]Massachusetts Institute of Technology — Prior research has found that regions of the superior temporal sulcus (STS) are engaged during a range of social and linguistic processes, including biological motion processing, face processing, theory of mind, syntax, semantics, phonology, and voice processing. Should the STS be characterized as multifunctional cortex, flexibly engaging in different processes depending on task demands, or is it composed of subregions specialized for specific processes? In the present study, we address this question by acquiring fMRI data on a range of tasks – including face perception, biological motion perception, theory of mind, language, and voice perception – in a single set of subjects. We find that different tasks evoke largely differing patterns of responses along the STS, but with some overlap between specific pairs. Responses to biological motion and theory of mind were nearby but largely nonoverlapping, pointing to dissociable systems for social processing along the STS. Additionally, STS responses to faces overlap posteriorly with regions responding to biological motion in point-light displays, and anteriorly with regions responding to human voices. Regions responding to human voices and to syntactic and semantic properties of linguistic input were largely nonoverlapping. Thus, the STS may include both multifunctional and functionally specific subregions.

C29

WILLIAMS SYNDROME SOCIAL-EMOTIONAL COGNITIVE AND PERCEPTUAL PROCESSES: EVIDENCE OF SOCIAL BIAS Rowena Ng[1], Anna Jarvinen-Pasley[1], Ursula Bellugi[1]; [1]Laboratory for Cognitive Neuroscience, Salk Institute for Biological Studies — Williams syndrome (WS) is genetic disorder characterized by hypersocial personality, i.e., increased propensity to approach strangers (Doyle et al., 2004) and attraction to faces (Jones et al., 2000), and social closeness (Klein-Tasman & Mervis, 2003). While WS individuals typically have cognitive impairment, face-processing is an unusual strength demonstrated by these individuals (Rose et al., 2007). For example, research shows WS participants perform better in emotion-identification of facial over scenic stimuli (Järvinen-Pasley et al., 2010). However, it is not clear if WS individuals show this social bias solely in the affective-cognitive sensory modality (emotion-recognition) or if it persists in the perceptual domain (emotion-discrimination). The present study addresses this question by administering emotion-recognition and discrimination assessments using social (faces, voices) and non-social (scenes, music) stimuli to WS and typical developing (TD) participants. Results on group differences indicate emotion-recognition and discrimination of faces are a relative strength in WS. Additionally, within WS group, social bias in both cognitive and perceptual domains was observed, regardless of the sensory stimuli (visual, auditory). Conversely, TD controls show social bias in emotion-identification but not affect-discrimination tasks. Thus, it appears in emotion-processing assessments that require greater cognitive resources, both WS and TD share a tendency to identify emotions of social stimuli (faces, voices) better than those non-social in nature (scenes, music). However, in less cognitive-laden emotion-perceptual tasks, WS continues to demonstrate this bias whereas TD controls do not. Altogether, WS process social information atypically in both cognitive and perceptual sensory modalities, mirroring their gregarious personality.

C30

NEUROIMAGING STUDIES OF NICOTINE ADDICTION AND OBESITY Vlad B. Papa[1], Laura E. Martin[1], Kevin Ruprecht[1]; [1]University of Kansas Medical Center — About 20 percent of the United States population currently smokes, and 30 percent of the United States population is obese (body mass index [BMI]?30 kg/m2. Tobacco use and obesity are the top preventable causes of death in the United States. Based on behavioral studies we know that smokers and obese individuals are more sensitive to signals of reward. Neuroimaging studies in smokers and obese participants show activations in the reward processing brain regions when smokers view smoking cues and when obese individuals view food cues. The current study used functional magnetic resonance imaging (fMRI) to examine the neural systems of reward among healthy weight and obese smokers to see if obese smokers responded differently than healthy weight smokers to food and smoking cues. To date six healthy-weight (BMI18.5 – 25) and five obese individuals have participated. Participants were scanned while viewing images of smoking and nonsmoking, as well as food and nonfood cues at least 4 hours following their last cigarette and meal. Preliminary results revealed Ventromedial Prefrontal Cortex responded more to food cues than smoking cues in both healthy weight and obese smokers despite increased urges to smoke among obese smokers. There were no significantly different brain responses to smoking cues, however obese compared to healthy weight smokers did show increases activations to food cues in the Left Anterior Insula. Consistent with past studies, we also found activations in the VMPFC between Food and Smoke cues among all participants.

C31

LINGUISTIC MARKERS OF EMOTIONAL ELABORATION IN THE PAST AND THE PRESENT IN ONLINE BLOGS Katherine Adams[1], Ethan Kross[1], Oscar Ybarra[1], Lisa Feldman Barrett[2,3], John Jonides[1], Sepandar Kamvar[4], Emre

Demiralp[1]; [1]University of Michigan, [2]Harvard Medical School, [3]Northeastern University, [4]Stanford University — Over 152 million blogs currently exist on the internet, many of which are used by their authors as a platform to share current, past, and predicted emotions. While large-scale data-mining of blogs has been a common practice in the information industry, blog content has only recently emerged as a venue for psychological research. By investigating the number of feeling words that a blogger uses in a blog sentence, we can characterize the degree to which individuals elaborate on their emotional experiences when describing them to the online community. In this study, data were obtained from the website, wefeelfine.org, which collects sentences from English language blogs containing the phrases, "I feel", "I felt", and other tenses of the verb "feel". The number of emotion words in each sentence was counted and used as a metric of emotional elaboration. The results show that sentences containing the phrase "felt" included significantly more emotion adjectives than those sentences that are formed from the words "feel," "feels," or "feeling." This suggests that writing about past emotional experiences leads individuals to use more elaborate and descriptive language compared to writing about current emotional experiences. Additionally, in sentences that contain the negatively valenced words "sad," "unhappy," "helpless," and "depressed," more emotion adjectives were used compared to sentences that contain the positively valenced words of "great," "better," "good," and "fine." This result suggests that describing negative emotional states requires a larger number of emotion adjectives compared to positive emotional states.

C32

SYNCHRONIZED EEG OSCILLATIONS FROM 2 INDIVIDUALS DURING SYNCHRONIZED ALTERNATE TAPPING Masahiro Kawasaki[1,2], Keiichi Kitajo[1,3,4], Yoko Yamaguchi[1,2]; [1]Rhythm-based Brain Computation Unit, RIKEN BSI-TOYOTA Collaboration Center, Japan, [2]Laboratory for Dynamics of Emergent Intelligence, RIKEN Brain Science Institute, Japan, [3]PRESTO, Japan Science and Technology Agency (JST), Japan, [4]Laboratory for Cognitive Brain Mapping, RIKEN Brain Science Institute, Japan — A synchronized behavior plays an important role in facilitation of our communications. This ability is supposed to be processed by mirror neuron system. However, there is little neurological evidence about synchronized brain activities from 2 individuals during achievement of cooperative communications. Here, we simultaneously recorded electroencephalograms (EEGs) from 2 subjects (in total, 40 right-handed subjects) during an alternate tapping task. In this task, 2 subjects individually faced to each PC display and tapped each key alternately with right index finger. When one and another subject tapped, a red and green square was presented, respectively. If a difference between time intervals of previous other's tapping (from self to other) and current self tapping (from other to self) was small (threshold: 50msec), a yellow square was presented. Subjects were instructed to tap the key with equal time interval of previous tapping of another subject. According to the behaviors, trials were divided into 4 conditions; self tapping and observation of other tapping with synchronized and desynchronized behaviors. The wavelet analyses for EEG data showed the 10Hz de-synchronizations, that is decrements of the oscillatory amplitudes, on the left central electrode before the onset of tapping during both the synchronized and desynchronized behaviors. The contralateral central de-synchronizations to using hand are known to be motor-related mu suppressions. Interestingly, the mu suppressions are also found in different activities for observation of other tapping between synchronized and desynchronized behaviors. These results suggested that the mu suppression would be associated with the mirror systems, especially the synchronized behaviors.

C33

TAKING ONE'S TIME IN FEELING OTHER-RACE PAIN: NEURAL ACTIVITY REVEALS DIFFERENT EMPATHIC RESPONSES TO PAIN OF OWN AND OTHER-RACE INDIVIDUALS Paola Sessa[1], Federica Meconi[1]; [1]University of Padova — The current study used event-related potentials (ERPs) to investigate the time-course of emphatic response to pain of White participants when exposed to stimuli showing own-race (White) or other-race (Black) neutral faces receiving painful (needle penetration) or non-painful (Q-tip touch) stimulation. Participants had to judge painful vs. non-painful pictures on each trial. The general structure of ERPs evoked by pictures was characterized by the N1 component, followed by the P2 and the N2 components. There was also another negative deflection peaking at 380 ms (N380) over the fronto-central area followed by a long-latency positivity between 380 and 650 ms (P3) with the maximum amplitude over the parietal area. In line with previous studies, the N1-P2-N2 complex was modulated as a function of race, indicating earlier orienting of attention to the more novel individuals (other-race faces; N1 and P2) and later and deeper orienting of attention to the more familiar individuals (own-race faces; N2). Notably, both the P2 and the N380 were modulated as a function of the interaction between the race of the faces and the stimulation condition, produced by a positive shift only when participants watched own-race faces penetrated by a needle. The P3 amplitude was modulated only by the stimulation condition, with larger amplitude for the painful stimulation. These findings support the notion of an early (automatic) empathic response to pain of own-race individuals, while empathy to pain of other-race individuals manifests only later, likely relying on slower controlled processing.

C34

THE NOVEL PSYCHOSIS RISK VARIANT RS7914588 AT CNNM2 IS ASSOCIATED WITH VARIABILITY IN SOCIAL COGNITIVE FUNCTION AND GRAY MATTER VOLUME. Emma Jane Rose[1,2], April Hargreaves[1,2], Derek Morris[1,2], Ciara Fahey[1,2], Michael Gill[1,2], Aiden Corvin[1,2], Gary Donohoe[1,2]; [1]Neuropsychiatric Genetics Group, Department of Psychiatry, Trinity College Dublin, [2]Trinity College Institute for Neuroscience, Trinity College Dublin — Introduction: A recent 'mega-analysis' identified five new genome-wide associated risk loci for schizophrenia (SZ), including rs7914558 within the cyclin M2 gene (CNNM2; OMIM:607803). The aim of this investigation was to ascertain the potential influence of rs7914558 on brain structure and neuropsychological function. Methods: Patients with SZ (N=400) and healthy controls (HC; N=160) completed a neuropsychological battery, which included measures of social cognition concerned with attributional style (e.g. the IPSAQ). In addition, structural imaging data (MRI/T1) were acquired from HC (N=159). Voxel based morphometry (VBM) was used to compare homozygous carriers of the risk 'A' allele to a cohort of non-risk carrying individuals (i.e. 'GG' & 'AG'). Results: CNNM2 genotype impacted two IPSAQ subscales. Risk carriers (AA or AG) had higher 'external positive' scores compared to homozygous 'G' individuals ($p<0.05$), whereas there was a linear effect of genotype on 'externalizing bias' such that GG>AG>AA ($p<0.05$). Thus, CNNM2 was associated with a tendency to attribute positive situations externally, and negative situations internally, i.e. in a manner that is inconsistent with self-serving bias. Post hoc region-of-interest VBM analyses focusing on brain regions relevant to our social cognitive findings revealed greater GM volumes in homozygous 'A' individuals compared to combined group of 'G' allele carriers in two putative social cognition regions – the right temporal pole and anterior cingulate (pcorrected(FWE)<0.05). Conclusions: The contribution of CNNM2/rs7914558 to SZ risk appears to be mediated by the influence of this variant on social cognitive function and structural variability in brain regions that support these processes.

C35

IMAGED ACTIONS PRODUCE AFFECTIVE REPONSES Valerie Dennehy[1], Amy E. Hayes[1], Nichola Callow[1]; [1]Bangor University, U.K. — Previous research has demonstrated that fluency of actions influences affective judgements of objects (Hayes, Paul, Beuger, & Tipper, 2008). This study aimed to investigate whether imaged motor actions influence affective responses to objects in the same manner as actually performing the movement. Forty-eight participants completed the Vividness of Movement Imagery Questionnaire – 2 (VMIQ-2) to assess imagery ability and were assigned to one of two groups; a movement imagery group (MIG), or a static imagery group (SIG). MIG participants imaged moving objects in one of

two ways; fluently (no avoidance of an obstacle) or non-fluently (avoiding an obstacle)...SIG participants imaged fluent and non-fluent conditions, but instead of motor imagery, imaged the fluent/non-fluent conditions as static scenes with no movement present. Results indicated that for MIG, liking ratings were higher for objects associated with fluent action conditions. For SIG, there was no significant difference in liking ratings for objects in fluent and non-fluent conditions. To examine the role of imagery ability in fluency dependent affect (difference between fluent affect scores and non-fluent affect scores), an additional sample of 41 participants were collected. The additional participants completed the MIG task and these data were then added to that of the original MIG group. For participants who adopted internal visual imagery perspective for the task (76% of participants), results indicated that higher kinaesthetic imagery ability was associated with greater fluency dependent affect. Taken together, these findings indicate that imaging non-emotive actions evokes emotional responses, and that imagery ability may moderate the response.

C36

EVIDENCE FOR DISSOCIABLE ROLES OF BASOLATERAL AND CENTRAL AMYGDALA IN HUMAN FEAR CONDITIONING Sabrina Boll[1], Matthias Gamer[1], Christian Buechel[1]; [1]University Medical Center Hamburg-Eppendorf — Human fMRI (functional magnetic resonance imaging) studies suggest a role for the amygdala in signalling computational learning signals such as prediction errors (differences between expected and actual outcomes) in appetitive and aversive (money loss) associative learning paradigms. However, a prediction error signal during aversive fear conditioning is yet to be unequivocally demonstrated. One possible shortcoming of previous fear conditioning studies in human fMRI research might relate to limitations in the spatial resolution that have hitherto prevented the functional segregation of different amygdala subregions. Here, we employed a first-order pavlovian fear conditioning procedure with a partial reinforcement schedule using electrical shocks as aversive reinforcers and combined this approach with high-resolution fMRI in order to differentiate the contributions of amygdala subregions. We show that prediction errors correlate with activation in the basolateral amygdala during the acquisition of conditioned fear – a region that is known to be subject of synaptic changes during learning of aversive fear memories in rodents. Signal changes associated with aversive outcomes (i.e. electrical shocks) in contrast, were observed in the central amygdala in line with its role as an output stage of the amygdala with projections to the peri-aqueductual gray and brainstem areas. These results provide unique insights into amygdala function during fear conditioning in the human brain and contribute to the knowledge of how associative fear memories are formed.

C37

GENETIC IMAGING OF THE ASSOCIATION OF OXYTOCIN AND ESTROGEN RECEPTOR GENE POLYMORPHISMS WITH HUMAN MATERNAL PARENTING Kalina J. Michalska[1], Benjamin B. Lahey[1], Jean Decety[1]; [1]The University of Chicago — Why do some mothers parent adaptively whereas others are neglectful or abusive? To understand the neurobiology of deficient human parenting and examine the relations between parenting behaviors and neural activation, we conducted a genetic functional magnetic resonance imaging (fMRI) study of 35 women selected on the basis of scores on observed parenting with their 4-6 year old children. When viewing a photo of their own child, relative to a photo of an unrelated child, mothers who engage in harsh parenting exhibited less hemodynamic response than other mothers in brain areas known to be involved in social cognition. Single nucleotide polymorphisms in the estrogen-? receptor gene were significantly associated with both negative parenting and neural responses to child stimuli in a band of regions from the left precuneus to the left frontal gyri. Conversely, hemodynamic responses in brain regions mediating reward and social behavior were significantly correlated with positive parenting. Polymorphisms in genes encoding oxytocin receptors were associated with variations in positive parenting with large effect sizes. Furthermore, genetic variants were significantly associated with neural responses to child stimuli in the same regions. This study is the first to integrate the methods of social neuroscience with genetic imaging and the psychology of maternal parenting to contribute to the emerging literature on the associations of estrogen and oxytocin with human social behavior. The findings open avenues to further delineate neural pathways from receptor gene variants to harsh maternal parenting, which can then be translated into methods of preventing maternal maltreatment of children.

EMOTION & SOCIAL: Person perception

C38

IMPAIRED BODY BUT NOT FACE PERCEPTION IN PATIENTS WITH OBSESSIVE-COMPULSIVE DISORDER Na Young Shin[1], Joon Hwan Jang[2], Geumsook Shim[2], Hye Yoon Park[2], Hee Sun Kim[2], Jae Yeon Hwang[2], Sung Nyun Kim[2], Jun Soo Kwon[2]; [1]Seoul National University, Seoul, Korea, [2]Seoul National University College of Medicine, Seoul, Korea — Empirical evidence involving the processing of social information by those with Obsessive–Compulsive Disorder (OCD) has been relatively scarce. Our study investigated the perceptual abilities of patients with OCD to recognize human faces and bodies. Fifty-four patients with OCD and 42 healthy controls performed discrimination tasks consisting of four types of stimuli: two sets of faces that were manipulated with regard to configuration and features, human bodies, and chairs. The stimuli were presented in upright and inverted orientations. It was found that patients with OCD were significantly less accurate in discriminating pairs of bodily postures implying actions. However, there was no significant difference between patient and control groups in the ability to recognize faces and chairs. The inversion effects for bodies and faces were also comparable between the two groups. The current findings suggest that patients with OCD experience difficulty in perceiving static forms of bodily postures, but are able to adequately recognize human faces. Our data indicate a selective deficit in the perception of bodily postures in those with OCD and suggest that this deficit is probably not related to the abnormal configurational processing of social objects. The loss of the ability to recognize bodily postures, which is an important source of social information, may impede adequate social interaction by patients with OCD. Key Words: Obsessive–Compulsive Disorder, Face recognition, Body perception, Social information processing, Configurational processing.

C40

MENTALIZING AND THE FUNDAMENTAL ATTRIBUTION ERROR Joe Moran[1], Eshin Jolly[1], Jason Mitchell[1]; [1]Harvard University — Explaining the sources of another's behavior is a task fraught with difficulty. Much evidence shows that observers gravitate to explaining people's behavior by appealing to internal dispositions and ignoring the influence of situational effects on that behavior – the fundamental attribution error. The psychological mechanism responsible for this error has remained elusive. Since our default tendency is to mentalize about people with whom we interact, we hypothesized that orienting to people's mental states might lead us to explain their behavior in terms of their dispositions, thus underlying the fundamental attribution error. During fMRI scanning, participants read stories that, in a separate group, attracted either mostly dispositional or mostly situational attributions. When participants read dispositional stories, greater activation was observed in dorsal medial prefrontal cortex and the temporoparietal junction. In a second analysis, we took advantage of the fact that certain stories attracted approximately even numbers of dispositional and situational attributions. For these stories, dorsal medial prefrontal cortex predicted later dispositional attributions. That is, even when story information was kept constant across dispositional and situational conditions, medial prefrontal cortex was preferentially activated when participants made dispositional attributions. These results suggest that a consequence of our default tendency to mentalize is a bias to make unwarranted assumptions about people's underlying behavioral dispositions which may underlie the fundamental attribution error.

C41

SOCIAL WORKING MEMORY: AN FMRI STUDY OF PARAMETRIC INCREASES IN SOCIAL COGNITIVE DEMAND Meghan Meyer[1], Robert Spunt[1], Elliot Berkmen[2], Shelley Taylor[1], Matthew Lieberman[1]; [1]University of California, Los Angeles (UCLA), [2]University of Oregon — Keeping track of varying amounts of social cognitive information, including people's mental states, traits, and relationships, is fundamental to navigating social interactions. However, the brain mechanisms supporting our ability to maintain and manipulate social cognitive information, or social working memory (SWM), remain elusive. On the one hand, the medial frontoparietal system and tempoparietal junction ('mentalizing system') engage in simple social cognition tasks and may therefore support SWM. On the other hand, this brain network reliably reduces activation as a function of traditional (i.e. non-social cognitive) working memory demand. The goal of the current study therefore was to examine if the mentalizing system increases in activation in response to SWM. We also explored whether the mentalizing system's response to SWM corresponded with individual differences in social cognitive ability. Parametric analyses showed increases in the mentalizing system as a function of the number of friends' considered along a trait dimension during the delay and probe response periods of the SWM task. Additionally, perspective-taking scores predicted activation in mentalizing regions during the delay period. These findings run counter to the common finding of parametric decreases in mentalizing regions as a function of working memory demand and suggest that the mentalizing network supports working memory for social cognitive information. Given that medial frontoparietal activity during the SWM task was linked to trait perspective-taking, a core social cognitive ability, social working memory capacity may be a useful new construct to explore social cognitive skill.

C42

ATYPICAL UNDERSTANDING OF OTHER INDIVIDUALS' MINDS IN RELATION TO SELF IN AUTISM Akiko Mizuno[1], Timothy A. Keller[1], Marcel Adam Just[1]; [1]Center for Cognitive Brain Imaging, Carnegie Mellon University — Atypical interpersonal cognition has been recognized as one of the pivotal characteristics of autism, known as a Theory of Mind (ToM) impairment. A recent study suggests that when making judgments about others, typically developing adults use their own mind as an anchor point, and make an adjustment based on the perceived difference relative to oneself (Tamir & Mitchell, 2010). This process is called "anchoring-and-adjustment," and appears to be mediated by the medial Prefrontal Cortex (mPFC). The present fMRI study investigates the specific hypothesis that an atypical anchoring-and-adjustment process in the mPFC is the neural basis of disturbed understanding of others' minds in relation to oneself in autism. Participants were 16 adults with high-functioning autism and 19 matched neurotypical adults. They made judgments about how well a series of personality statements apply to individuals whose states and actions were described in a brief passage. The within-group analyses revealed that only the autism group exhibited near absent mPFC activation while mentalizing about other individuals who are dissimilar from themselves ("Dissimilar" trials), whereas the control group showed mPFC activation similar to that observed by Tamir and Mitchell (2010). The between-group comparison showed a complimentary result, by exhibiting significantly reduced mPFC recruitment during the "Dissimilar" trials in the autism group. The results indicate that atypical interpersonal cognition among individuals with autism may reflect disturbed interpretation of the social world in the relation to oneself, as well as disturbed mPFC recruitment as a potential neural basis for atypical understanding of other individuals' mind in autism.

C43

NEURAL BASIS OF NON-VERBAL SOCIAL INTERACTIONS: A DUAL-EEG STUDY Mathilde Menoret[1], Aurore Curie[1], Vincent des Portes[1], Tatjana A. Nazir[1], Yves Paulignan[1]; [1]L2C2, Laboratory on Language, Brain and Cognition, CNRS-UCBL, Lyon, France — Encoding of non-verbal social interactions has to be dynamic in order to optimally respond to environmental changes in a social context. Understanding online-processes of social interactions in the brain is therefore an important challenge. For this, we recorded dual-EEG and kinematics from two participants, an "actor" and an "observer", in a real face-to-face paradigm implying or not a complementary action (e.g. the actor presents a saucer and the observer places the corresponding cup or does nothing). We compared EEG signals of both participants (i.e. oscillations in 10Hz and 20Hz frequency bands, which index cortical motor activity) in the two experimental conditions. By synchronizing EEG on the onset of actor's movement, a clear indicator of social interaction became evident in both participants. For the actor, who always performed an action, suppression of 10Hz and 20Hz oscillations was observed starting around movement onset. Interestingly, this suppression was stronger when the action implied a response from the observer despite the fact that kinematics of actor's movement was identical in the two conditions. For the observer, there was no modulation of the 10Hz band. However, similar to the actor, clear 20Hz suppression emerged at about 200 ms after onset of actor's movement. Importantly, here as well, suppression was stronger in the social-interaction condition. Hence, acting in a social context mobilizes processes visible in motor specific brain oscillations. Differential effects observed between actor and observer further suggest that these processes depend on the assignment of each participant's role in communication.

C45

EVIDENCE FOR CROSS-GENDER EFFECTS ON ATTENTIONAL AND CATEGORICAL PROCESSING OF FACES Robin Goodrich[1], Jason Samaha[1], Lars Hedin[1], Darwin Guevarra[1], Sierra Niblett[1], Avi Ben-Zeev[1], Mark W. Geisler[1]; [1]San Francisco State University — The tendency for individuals to exhibit recognition deficits for outgroup faces and enhanced performance for ingroup faces is a well-established phenomenon that is, in part, due to outgroup homogeneity effects. While strong cross-gender effects have been found in studies using behavioral or self-report measures, electrophysiological results on the interaction between face gender and participant gender remain ambiguous. Thus, the goal of this study was to examine the influence of cross-gender effects on early attentional processes and subsequent categorization using event-related brain potentials (ERPs). Participants completed a modified oddball task in which they were presented with all male (n = 6) or all female (n = 4) faces; same-gender stimulus sets were created to ensure equivalent perceptual homogeneity between stimulus gender conditions. Preliminary analyses revealed cross-gender effects, such that outgroup faces elicited larger N2 and P3 components than ingroup faces; P2 amplitude did not differ between conditions. Our results suggest that cross-gender faces were identified as outgroup faces, and required more visual attention for processing than same-gender faces, within 250 ms of stimulus onset. Furthermore, the enhanced working-memory and event categorization processes observed in the cross-gender condition, as indexed by the P3, demonstrates that perceptual homogeneity of outgroup faces was magnified. These findings are in line with cross-gender effects observed in past behavioral studies and provide electrophysiological support for the existence of outgroup homogeneity effects. Such automatic and implicit cross-gender effects during person perception are particularly important given the powerful social-psychological consequences they may carry for certain social groups.

C46

P300 AMPLITUDE AS AN INDEX OF MEMORY DISTORTIONS FOR SKIN TONE Branden Kolarik[1], Tara Dennehy[2], Jason Samaha[3], Robin Goodrich[3], Avi Ben-Zeev[3], Mark Geisler[3]; [1]University of California-Davis, [2]University of Massachusetts-Amherst, [3]San Francisco State University — This study investigated whether a stigmatized person's skin tone can be distorted in memory as a function of a stereotypic social label using scalp recorded EEG and a modified visual oddball task where each image occurred with equal probability. Twelve participants were presented with a masked prime of "Ignorant" (stereotypic), or "Something" (baseline) before studying an image of a Black male on a computer screen. Following a 1-minute filler task, participants performed a test of recognition involving the original face (target) and six modified faces (non-targets: 25%, 37% and 50% darker and lighter skin tone). All images were presented one at a time for 250ms and occurred with equal probability to ensure that any recorded changes in the EEG were due to the stimulus features and not probability of occurrence. As predicted by our hypotheses and previously collected behavioral data, participants who were primed with the baseline "Something" showed larger P300 amplitude to the original photograph and lower amplitude P300-like responses to the other images. When primed with "Ignorant" there was a larger amplitude P300 for the 25% and 37% darker images. ERP amplitudes were similar across both accurate and inaccurate recognition trials. The finding that the P300 amplitude was similar across trials regardless of accuracy on the task, (Accuracy for both conditions = 67.5%, SD = 9.07), suggests that the P300 can be used as an index of memory distortion for a stimulus feature.

C47

ON THE ROLE OF THE ANTERIOR TEMPORAL LOBE IN SOCIAL COGNITION: NEUROPSYCHOLOGICAL EVIDENCE Caroline Michel[1], Agnesa Pillon[1], Adrian Ivanoiu[1], Dana Samson[1]; [1]University of Louvain, Belgium — Neuroimaging studies have shown that the anterior temporal lobes (aTLs) are part of the neural network commonly activated when people are engaged in Theory of Mind (ToM) tasks. However, the functional role of the aTLs in social cognition still remains to be clarified. Based on the observation that these structures are not only involved in social cognition tasks but also in semantic processing, some authors have recently hypothesized that the aTLs contribute to ToM by subtending the abstract representations of social concepts that we need to infer other people's mental states (e.g., Ross & Olson, 2010). Compatible with this view, these regions have been shown to be preferentially activated for social as compared to non-social concepts in neuroimaging studies (e.g., Zahn et al., 2007). Here, we report the case of a patient, C.M., who suffers from conceptual/semantic deficit following a brain degeneration affecting mainly the left anterior temporal lobe. On several semantic tasks, C.M. appeared to be equally if not less impaired for social compared to non-social concepts. Furthermore, despite his lesion, the patient was perfectly able to infer other people's mental states in non-verbal tasks. These findings challenge the hypothesis regarding the functional role of the aTLs in ToM: they suggest that (i) the left aTL is not specifically (if at all) dedicated to the storage of social concepts that would be needed to infer other people's mental states and, (ii) despite its recurrent activation in neuroimaging studies, the left aTL is not even necessary for inferring mental states.

EXECUTIVE PROCESSES: Development & aging

C48

AGE-RELATED DEFICIT OR FOCUS ON ACCURACY OVER SPEED? ERP EVIDENCE FOR AGE DIFFERENCES IN REACTIVE COGNITIVE CONTROL Daniela Czernochowski[1], Julia Saße[1], André Haese[1]; [1]Heinrich-Heine-University, Düsseldorf — According to the dual mechanisms of control framework (Braver et al., 2007), two alternate routes may lead to correct response selection. When response conflict is detected, reactive control processes are recruited immediately before the response, at the expense of longer RTs. If advance preparation is feasible, control can be recruited proactively to allow for both rapid and correct response selection. Previous research (Czernochowski et al., 2010) has demonstrated that older adults rely predominantly on reactive control. However, so far it is unclear whether this age difference reflects a preference for accuracy over speed or older adults' deficit in recruiting proactive control. Here, young (20-25 years) and older (65-74) participants were instructed to emphasize either accuracy or speed in separate blocks during a cued task-switch paradigm. Event-related potentials (ERPs) were recorded to determine potential age differences in the neural correlate for reactive control (pre-response negativity, PRN). Behavioral data indicate that adjustments in response criteria in terms of speed and accuracy were larger in young compared to older participants. Starting around 200 ms pre-response, the corresponding ERPs revealed a (left-) frontal PRN for both age groups. In young adults, it was observed selectively for task switches under accuracy instructions, but across task-conditions for older adults. Together, these results suggest that young adults are able to flexibly adjust their response criteria and to recruit reactive control selectively to meet higher task demands. By contrast, older adults appear unable to relax their strict response criterion and rely on reactive control irrespective of task demands.

C49

THE AGING PULSE: REGIONAL ARTERIAL ELASTICITY IN THE BRAIN IS ASSOCIATED WITH FITNESS AND COGNITIVE PERFORMANCE. Chin Hong Tan[1], Benjamin Zimmerman[1], Kathy Low[1], Nils Schneider-Garces[1], Mark Fletcher[1], Timothy Weng[1], Ed Maclin[1], Gabriele Gratton[1], Monica Fabiani[1]; [1]University of Illinois at Urbana-Champaign — Cognitive changes are associated with normal aging, including declines in working memory and executive function/attentional control. Some of these changes may be related to arteriosclerosis, i.e., loss of arterial elasticity. Cardiopulmonary fitness may prevent arterial stiffness and help cognitive functioning by improving oxygenation and perfusion conditions in the brain. Optical methods based on near-infrared (NIR) light provide a sensitive measure of arterial pulse in the brain that can reveal changes in arterial elasticity. Accurate localization is achieved by using a full-head coverage optical montage and coregistering it with each individual's structural magnetic resonance image (MRI). An estimate of local arterial elasticity is obtained by time locking the signals to the R-wave of the electrocardiogram (EKG) and determining the latency associated with 75% return from peak systole to diastole (pulse return) in different brain regions. Studying participants ranging in age from 55 to 87, we found that average pulse return across the cortex was correlated with physical fitness. Localized pulse return estimates in the left and right frontal cortex were correlated with several neuropsychological measures of working memory and executive function, while verbal fluency was correlated with overall average pulse return. Measurements of pulse using diffusive optical methods may thus provide information on the relationship between cerebrovascular and cognitive health. Further, regional measures of arterial stiffness could be used in the future as predictors of specific patterns of cognitive decline.

C50

ABNORMAL ATTENTIONAL BLINK PERFORMANCE IN ADULT MALE CARRIERS OF THE FRAGILE X PREMUTATION ALLELE MAY BE DUE TO DECREASED WORKING MEMORY CAPACITY Ling M. Wong[1,2], Tony J. Simon[1,2]; [1]University of California, Davis, [2]M.I.N.D. Institute, Sacramento, CA — OBJECTIVE: Fragile X premutation carriers (fXPCs) have an expanded CGG trinucleotide repeat size within the FMR1 gene, and have increased risk of developing Fragile X-associated Tremor Ataxia Syndrome (FXTAS), often characterized by impaired attentional control. The attentional blink (AB) describes the reduced identification accuracy for the second of two targets presented in close temporal proximity within a rapid visual stream of distractors, and may reflect attentional control ability (Temporary Loss of Control model; see Di Lollo 2005). In this study, we tested whether adult male fXPCs asymptomatic for

FXTAS exhibited impaired attentional control in this task. METHOD: Participants were fXPC and healthy control (HC) men aged 22-35. Each trial consisted of 5-10 digits, 3 target items, and one final digit. In the Uniform condition, all 3 targets were letters. In the Varied conditions, the targets were a letter-number-letter sequence. In the Varied-2 condition, only the letters were to be reported, and in the Uniform and Varied-3 conditions, all 3 targets were to be reported. RESULTS: In both groups, T3 identification performance was worse in the Varied relative to Uniform conditions, and equivalent between the Varied-2 and Varied-3 conditions. FXPCs showed impaired T3 relative to T2 performance in the Uniform condition. CONCLUSIONS: Abnormal performance in fXPCs could be due to decreased working memory capacity, which would differentially affect the Uniform condition given specific response strategies. This suggests that impairments in working memory may interact with attentional control in adult male fXPCs.

C51

PUBERTAL DIFFERENCES IN THE NEURAL SUBSTRATES OF COGNITIVE CONTROL DURING ADOLESCENCE Madison L. Stroup[1], Kristen L. Mackiewicz Seghete[1], Stephanie F. Sasse[1], Megan M. Herting[1], Bonnie J. Nagel[1]; [1]Oregon Health & Science University — Puberty is a developmental period characterized by profound changes in social, emotional, and cognitive functioning. However, the extent to which developmental differences in cognitive processes are related to puberty, rather than chronological age, remains unclear. Thus, the goal of the current study was to investigate whether pubertal status, controlling for age, differentially affects cognitive control mechanisms using functional magnetic resonance imaging (fMRI) and a counting Stroop task. To examine the effect of pubertal status on the neural substrates of cognitive control, we divided 46 participants into early to mid-puberty (mean estimated Tanner stage=2.46±.1.18) and mid- to late puberty (mean estimated Tanner stage=3.48±.1.08) groups, matching for age and gender (22 females; mean age=13.42±.1.6). No significant group differences in task performance were observed. Using analysis of covariance, controlling for reaction time, we examined brain activity during incongruent compared to neutral trials. Results indicated that, on average, adolescents at later pubertal stages showed significantly greater activity in the right dorsolateral prefrontal cortex (DLPFC) during incongruent compared to neutral trials and significantly greater activity in the fusiform gyrus during both incongruent and neutral trials (in contrast to baseline) compared to those earlier in puberty ($p<0.05$, whole-brain corrected). Given the importance of the DLPFC for executive control and the fusiform gyrus for processing task relevant attributes, under-recruitment of these brain regions earlier in puberty may suggest weaker top-down cognitive control and decreased ability to maintain an attentional task set during earlier stages of pubertal development.

C52

EFFECTS OF DIFFERENCES IN WORKING MEMORY SPAN ON THE PATTERN OF BOLD FMRI RESPONSES IN MIDDLE-AGED AND OLDER ADULTS. Nils Schneider-Garces[1], Mark Fletcher[1], Tim Weng[1], Tauheed Ali[1], Kathy Low[1], Gabriele Gratton[1], Monica Fabiani[1]; [1]University of Illinois at Urbana-Champaign — Working memory (WM) performance declines with age. It has been suggested that the additional processes required by higher WM loads pose a particular problem for older adults. However, a previous study using a Sternberg paradigm (Schneider-Garces et al., 2010) found that, after equating for WM span differences, older adults showed activation-by-load functions similar to younger adults. In the present study using the same paradigm, we extended our age range to include middle-age adults to achieve a more continuous sample. We also increased the highest load condition to set size 8 to examine supra-span performance in all subjects. We recorded behavioral and Blood-oxygen-level dependence (BOLD) functional magnetic resonance imaging (fMRI) data from 46 adults ranging from 55 to 87 years of age, with set sizes of 2, 4, 6, and 8 consonants. Older adults were less accurate and slower than middle aged adults, especially at the higher set sizes. For the fMRI data, slope analyses were performed separately for set sizes 2-4, 4-6, and 6-8. All age groups showed an increase from set size 2-4 in a network of occipital, parietal, and frontal regions. However, when subjects were sorted by memory span, the low-span group showed the strongest increase at load 2-4, whereas high-span subjects' increases were shifted to loads 4-6 and 6-8. This is further evidence that WM span is important in the evaluation of WM-related activation in older adults.

C53

CHANGES IN LOCAL AND GLOBAL BRAIN ORGANIZATION IN HEALTHY AGING Courtney L. Gallen[1], Emi M. Nomura[1], Caterina Gratton[1], Mark D'Esposito[1]; [1]University of California, Berkeley — Resting-state functional brain networks are known to have a small-world structure and modular organization, reflecting efficient information transfer on local and global scales. However, it is not fully understood how such network properties change in normal aging. Here, we use resting-state fMRI (rs-fMRI) to compare the global and local organization of brain networks between 48 healthy older (ages 60-80) and younger (ages 18-36) adults. Five minutes of rs-fMRI data was collected in each participant, preprocessed as in Fox et al. (2005), and correlation matrices were created reflecting functional connectivity between 90 AAL atlas nodes. These matrices were thresholded and used to create undirected, unweighted graphs which we then evaluated using Newman's modularity (ratio of intra- to inter-module connections), small-worldness (ratio of clustering coefficient to path length), and average Euclidian distance of paths between nodes. Additionally, the hub- and connector-ness of 10 nodes from lateral prefrontal cortex (PFC) and occipital/motor regions were assessed. Modularity and small-worldness were reduced in older participants, while path distance was increased relative to younger participants. Further, PFC nodes showed reduced hub and connector properties, while those in occipital and motor cortices remained unaffected by age. These results suggest that aging impacts the global and local organization of the brain. Local metrics of nodal importance within the lateral PFC highlight this region as particularly susceptible to age-related changes. Future work will relate these metrics to cognitive performance as changes in neural organization, namely in PFC, may contribute to cognitive decline in aging.

C54

NON-INVASIVE MEASURE OF BLOOD FLOW TO THE BRAIN IS ASSOCIATED WITH POORER STRATEGIC RETRIEVAL AND OUTPUT MONITORING IN HEALTHY OLDER ADULTS Myra Fernandes[1], Andrew Robertson[1], Suzanne Tyas[1], Eric Roy[1], George Heckman[1], Richard Hughson[1]; [1]University of Waterloo — Neuropsychological research suggests that performance on tests that require executive functions, specifically strategy use, organization, and monitoring, are critically dependent on brain integrity, particularly in frontal cortex. As we age, our blood vessels lose some of their elasticity which, in turn, affects how much the vessels can stretch with each heartbeat, and their capacity to deliver oxygen-rich blood to the brain. One measure of integrity of brain vasculature is its responsiveness to the demand for blood flow in response to a non-invasive manipulation, known as carbon dioxide (CO2) reactivity. Brain blood flow velocity through the middle cerebral artery was measured using Transcranial Doppler ultrasound. Reactivity was assessed by quantifying the percent increase in blood flow velocity in response to breathing a hypercapnic gas mixture (5% CO2, 21% O2). Participants' performance on a standard battery of neuropsychological tests, including the Wisconsin Card Sorting Task (WCST), the Trail Making Test, California Verbal Learning test (CVLT), and Warrington words and faces was also assessed. Data show that in healthy older individuals (over age 65), higher CO2 reactivity, indicative of a higher potential to deliver oxygen to the brain, was significantly positively correlated with semantic clustering scores ($p < .05$) on the CVLT memory test, at both short and long delays. Perseveration errors on the WCST showed a trend to decrease as CO2 reactivity increased. No other neuropsychological test showed such associations. Results suggest that executive functions such as those required to organize and monitor output are most sensitive to changes in cerebrovascular health.

C55

DECOUPLING OF THE REWARD AND WORKING MEMORY NETWORK IN CHILDREN. Michael Tennekoon[1], Gillian Cooke[1,2], Jessica Gayda[1], Mark Stein[1,3], James R Booth[1]; [1]Northwestern, [2]University of Illinois at Urbana-Champaign, [3]University Of Illinois at Chicago — Reward regions such as the nucleus accumbens (NA) may play a crucial role in gating information flow in the parieto-frontal working memory network (WMN). Furthermore studies have suggested that informative feedback alone can act as a reward. We used a verbal n-back task to investigate the developmental differences in the effects of reward and feedback on the WMN. For large rewards, adults showed greater activation for immediate versus delayed feedback in both the WMN and NA, and the difference scores were correlated between regions. With delayed feedback, adults showed greater activation for small versus large rewards in both the WMN and NA, and again the difference scores were correlated between regions. Children (9- to 11-year-olds) showed the effects of feedback and reward in the NA, but not in the WMN, and activity was not correlated between NA and WMN. Taken together, our study suggests that in adults, when large rewards are given with immediate feedback, reward regions allow information to flow within the WMN. Under conditions of delayed feedback, large rewards may create a pressure to protect representations, resulting in reward regions preventing information flow. Conversely, small rewards may be treated as inconsequential, and hence did not generate pressure to protect representations. For children, the NA and WMN appear to be decoupled so that the gating mechanism controlled by the NA cannot effectively influence information flow within the WMN.

C56

WORKING MEMORY LOAD-RELATED ACTIVITY VARIES IN AGING: A TEST OF COMPETING NEUROCOGNITIVE AGING THEORIES Ilana J. Bennett[1,2], Hannah G. Rivera[1], Bart Rypma[1,2,3]; [1]Center for Brain Health, University of Texas at Dallas, [2]School of Behavioral and Brain Sciences, University of Texas at Dallas, [3]Department of Psychiatry, University of Texas Southwestern Medical Center — Multiple theories have been proposed to account for relationships among neural activity, cognitive performance, and age group. Neural efficiency frameworks (NEFs), for example, propose that efficient young are able to minimize neural processing and maximize cognitive performance, whereas reduced efficiency in older adults results in increased activity and impaired performance. Similar activity-performance relationships are predicted by other theories, such as those proposing that age-related reductions in cognitive capacity result in increased compensatory recruitment. The present study directly compared these competing models using same dataset of 22 younger and 20 older adults who performed a Sternberg working memory task during functional magnetic resonance imaging (fMRI). In this task, participants encoded either 2 or 6 letters (i.e. the load manipulation), maintained them during a delay, and then responded whether a single probe matched an item from the memory set. Behavioral results revealed faster and more accurate responses to the low versus high load condition, with age group differences in this load condition effect for the accuracy measure. Consistent with both models, the fMRI results showed less neural activity for the low versus high load condition in younger adults, but greater activity for the low versus high load condition in older adults. However, older adults showed no significant differences in working memory load-related activity when they were separated according to whether they had high versus low working memory capacity as would be predicted by models of capacity-related compensation. Thus, taken together, these data support interpretations consistent with models of NEFs.

C57

WHITE MATTER MICROSCTRUCTURE AND COGNITIVE CONTROL IN A DEVELOPMENTAL SAMPLE Kristen L Mackiewicz Seghete[1], Megan M Herting[1], Bonnie J Nagel[1]; [1]Oregon Health & Science University — Studies have established networks of brain regions recruited for cognitive control during development, but less is known about how white matter microstructure in children and adolescents relates to cognitive control. This study explored the relationship between white matter microstructure and inhibition in a sample of 35 children and adolescents (age 10-15, mean = 12.93; 17 female). Fractional anisotropy (FA) values, indexing water diffusivity in white matter, were derived from diffusion tensor imaging using Tract-Based Spatial Statistics. Youth completed the Color-Word Interference task from the Delis-Kaplan Executive Function System, a modification of the Stroop paradigm. The scaled contrast score for Inhibition compared to Color Naming was the behavioral measure of cognitive control, with higher scores representing relatively better performance on the Inhibition than Color Naming task. Scaled contrast scores were regressed on the FA white matter skeleton, controlling for IQ. Results demonstrated greater FA in the left external capsule and left cerebellum were associated with higher contrast scores, whereas greater FA in white matter along the left inferior frontal gyrus was associated with lower contrast scores ($p<.05$, whole-brain corrected). These results suggest a greater ability to inhibit irrelevant word information is related to greater integrity of white matter microstructure in regions supporting cross-cortical projections and less white matter microstructure in regions representing word representation. Given that prefrontal regions subserving cognitive control continue to develop through adolescence, white matter related to coordinating cross-cortical communication and reducing the processing of task-irrelevant information may be particularly important when selectively attending to task-relevant information.

EXECUTIVE PROCESSES: Monitoring & inhibitory control

C58

RESPONSE INHIBITION IN INDIVIDUALS WITH PSYCHOPATHIC TENDENCIES USING A VISUAL GO/NOGO TASK: AN EVENT-RELATED POTENTIALS STUDY Young Youn Kim[1]; [1]Kyonggi University — This study investigated response inhibition in undergraduate students divided into psychopathic tendencies and control groups according to the scores of Psychopathic Personality Inventory-Revised. Event-related potentials were collected as participants performed visual Go/NoGo discrimination task that required participants to respond to Go condition (circle stimuli) and to inhibit response to NoGo condition(square stimuli). The response inhibition was investigated in the NoGo condition. The statistical analysis of P3 elicited by NoGo stimuli indicated that psychopathic tendencies group showed significantly reduced NoGo-P3 amplitudes than the control group at the central area. In Wisconsin card sorting test, the psychopathic tendencies group showed significantly higher perseverative response and perseverative error than the control group. These results support the hypothesis that the neural processes involved in response inhibition are abnormal in individuals with psychopathic tendencies.

C59

THE ROLE OF DORSOLATERAL PREFRONTAL CORTICES IN POST-ERROR SLOWING: A SINGLE PULSE TRANSCRANIAL MAGNETIC STIMULATION CHRONOMETRIC STUDY. Aurélie Manuel[1,2], Francisco Bravo[1,2], Roland Vocat[3], Ayse At[1], Gilles Pourtois[4], Lucas Spierer[1,5]; [1]Department of Clinical Neurosciences, Vaudois University Hospital Center and University of Lausanne, Lausanne, Switzerland, [2]Department of Psychiatry, Vaudois University Hospital Center and University of Lausanne, Lausanne, Switzerland, [3]Department of Neuroscience and Clinic of Neurology, University of Geneva, Geneva, Switzerland, [4]Department of Experimental Clinical and Health Psychology, Ghent University, Ghent, Belgium, [5]Department of Medicine, Neurology Unit, University of Fribourg, Fribourg, Switzerland — Adjusting behavior following the detection of inappropriate actions allows flexible adaptation to task demands and environmental contingencies during goal-directed behaviors. Post-error behavioral adjustments typically consist in adopting more cautious response mode, which manifests as a slowing down of response speed. Although converging evidence point to the involvement

of the dorsolateral prefrontal cortex (DLPFC) in post-error behavioral adjustment, whether and when the left or right DLPFC is critical for post-error slowing (PES), as well as the underlying brain mechanisms, remain open questions. To address these issues, we used single-pulse transcranial magnetic stimulation in healthy human adults with the aim to disrupt the left or right DLPFC selectively at various delays within the 30-180ms interval following false alarms commission and hits, while participants preformed a standard visual Go/NoGo task. PES significantly increased after TMS disruption of the right DLPFC at 150ms post-FA response. By contrast, magnetic stimulation of the same region after hits did not influence subsequent response time. These results are discussed against the notion of the involvement of the right DLPFC in downplaying the detrimental effects of error detection on subsequent behavioral performance, as opposed to implementing adaptative error-induced slowing down of response speed.

C60

CONTEXTUAL TASK DIFFICULTY MODULATES STIMULUS DISCRIMINATION: ELECTROPHYSIOLOGICAL EVIDENCE FOR INTERACTION BETWEEN SENSORY AND EXECUTIVE PROCESSES John Fedota[1], Craig McDonald[1], Raja Parasuraman[1]; [1]George Mason University — Theoretical models of executive control in the human brain suggest that difficult tasks require top-down executive control, which influences accurate sensory processing. However, the event-related potential (ERP) component most associated with stimulus discrimination, the occipital-temporal N1, has not consistently been shown to be sensitive to the difficulty of stimulus discrimination. The current paradigm manipulated the difficulty of the required stimulus discrimination not by cluttering the visual field as in previous studies, but by manipulating the similarity between serially presented targets and non targets. Critically, the same target stimulus was employed in both easy and difficult discrimination contexts. Consequently, our difficulty discrimination manipulation necessarily implicates trial-to-trial executive control as opposed to within trial, bottom-up changes in sensory processing. The N1 and P3b components were evaluated as indices of discrimination and categorization, respectively. Physically identical target stimuli elicited a larger N1 and smaller P3b in the hard task context as compared to the easy task context. Moreover, when targets were incorrectly categorized, N1 amplitude was diminished and a P3b was not elicited. Thus, the current study provides evidence that the N1 component indexes a sensory discrimination process that is modulated by executive control.

C61

INEFFICIENCY OF POST-ERROR ADJUSTMENT IN IMPULSIVE VIOLENT OFFENDERS Chiaoyun chen[1], Jia-Ren Chang[2], Daisy L. Hung[3]; [1]Department and Graduate Institute of Criminology, National Chung Cheng University, [2]Institute of Neuroscience, National Yang-Ming University, [3]Institute of Cognitive Neuroscience, National Central University — Repeated impulsive violent offenders are often described as impairment in inhibitory control and error processing. A flanker task (interference control) with a stop-signal task (behavior inhibition) was used to examine conflict monitoring, error detection, and post error processing. The ERP results showed that no group differences were seen in incompatibility Go N2 and ERN, indicating that the impulsive violent offenders may have normal conflict monitoring and error detection. The amplitude of stop signal N2 of successful inhibition trials at the frontal area reflected different degrees of inhibition in impulsive violent offenders compared with matched controls. The stop signal N2 was significantly lower in the impulsive violent offenders than in matched control. This showed that they might have difficulties in inhibitory control. A reduced Pe at the parietal area was seen in the impulsive violent offenders. The behavioral data indicated that the impulsive violent offenders did not show post-error slowing compared with control group. We suggested that they had problems in the error awareness, the subjective emotional error assessment process and error correction.

C62

THETA AND ALPHA DYNAMICS REVEAL DIFFERENT TYPES OF ERROR DETECTION AND ADAPTATION Joram van Driel[1], Michael X Cohen[1,2]; [1]University of Amsterdam, [2]University of Arizona — Performance errors in conflict tasks are thought to signal the need for increased control over the motor system. However, errors may also result from lapses in sustained attention, which may require different adaptation mechanisms. In this study we measured EEG during three variants of a Simon task in which errors were more likely to occur due to attentional lapses, failures of motor control, or both. Importantly, these conditions only differed in task instructions on speed and accuracy, in block length, and in trial predictability. Behavioral results showed that subjects exhibited less conflict-effects in the sustained attention condition compared to the other conditions. In addition, there was no error speeding in the sustained attention condition, while the other conditions did show faster error trials than correct trials. Crucially, time-frequency analyses showed that the sustained attention condition, compared to the motor control condition, was characterized by: 1) less error-related MFC theta (4-8 Hz) power and less MFC–dlPFC theta synchronization; 2) stronger error-related suppression of parieto-occipital alpha (8-12 Hz) power and stronger parieto-occipital–frontal alpha synchronization. Together, these results show that minor differences in cognitive control paradigms can result in different post-error brain dynamics. Averaging together all errors during typical cognitive control tasks may thus result in heterogeneous activity from multiple neurocognitive processes.

C63

RISK AVERSION UNDERLIES MEDIAL PREFRONTAL CORTEX ACTIVITY IN SUBSTANCE DEPENDENCE William Alexander[1], Rena Fukunaga[1], Joshua Brown[1]; [1]Indiana University, Bloomington — Substance dependence is frequently associated with deficits in decision-making and cognitive control of behavior. Despite this link, however, the influence of substance dependence on the function of brain regions implicated in cognitive control, especially medial prefrontal cortex (mPFC), remains unclear. Psychologically, a number of mechanisms have been suggested by which substance dependence may impair behavior, including: risk-seeking behavior resulting from increased reward salience, underweighting past events either through increased attention to more recent outcomes or disruption of learning processes, a general disruption of learning due to decreased attentional function, or, more controversially, increased risk aversion. In this study, we attempt to distinguish amongst these hypotheses with a combined fMRI/computational modeling study. First, using a computational model of mPFC, the Prediction of Responses and Outcomes model, we derive predictions for the expected pattern of activity in mPFC under the hypotheses outlined above. Second, we test these predictions using fMRI to record brain activity in substance-dependent individuals and non-substance dependent individuals performing a version of the Change Signal task in which the likelihood of error commission and expected magnitude of reward for correct and incorrect performance were manipulated. We find that activity in mPFC for substance-dependent individuals is consistent with the hypothesis that aversion to risk influences activity in mPFC, and is inconsistent with other possible explanations.

C64

ABSENCE OF CONFLICT ADJUSTMENT FOLLOWING TWO CONSECUTIVE CONFLICT TRIALS: AN FMRI STUDY Chobok Kim[1], Nathan F. Johnson[1], Brian T. Gold[1]; [1]University of Kentucky — Conflict adjustment includes faster reaction times on incongruent trials preceded by incongruent (iI) trials when compared to incongruent trials preceded by congruent trials (cI). According to the conflict monitoring hypothesis, anterior cingulate cortex (ACC) and dorsolateral prefrontal cortex (DLPFC) play critical roles in conflict adjustment through detecting (ACC; monitor) and regulating (DLPFC; controller) conflict. It predicts that cI trials yield greater ACC activity when compared to iI trials, whereas iI trials yield greater DLPFC activity when compared to cI trials. Although many studies have

focused on the effect of the preceding (N-1) trial type on the current (N) trial, no study has investigated the effect of the N-2 trial type. In this study, we employed the Stroop task to test whether conflict adjustment is affected by the N-2 trial using an event-related design. The task design included three factors (N-2, N-1 and N) with congruent (C) and incongruent (I) trial types, resulting in 8 different trials types: ccC, ciC, icC, iiC, ccI, ciI, icI, and iiI. Behaviorally, conflict adjustment was observed only when N-2 trials were congruent. Imaging results demonstrated that ACC activity was greater for ccI when compared to ciI, whereas it was lower in icI when compared to iiI. DLPFC demonstrated the opposite pattern (ciI > ccI and icI > iiI). These findings suggest an absence of conflict adjustment following two consecutive conflict trials. We propose that the monitor-controller loop appears to be refreshed or reset after two consecutive conflict trials in order to perform the current task.

C65

BEYOND THE ANTERIOR CINGULATE CORTEX: CONFLICT AND ERROR PROCESSING IN AN EXTENDED CINGULO-OPERCULAR NETWORK

Karla Becerril[1], Deanna Barch[2]; [1]Neuroscience Program, Washington University in Saint Louis, [2]Departments of Psychology, Neurology, and Radiology, Washington University in Saint Louis — The successful regulation of behavior requires brain systems capable of detecting increasing cognitive demands and implementing control accordingly. Despite the wealth of data involving the anterior cingulate cortex (ACC) on these processes, accurate performance monitoring and behavioral adjustments are unlikely to rely on a single region. Prior research shows that a distributed network, not just the ACC, responds to errors. We contrasted error and conflict activity during a change-signal task (n=32) in all regions identified to show error-related activity in the cingulo-opercular and cerebellar networks, and examined the relationship between brain activity and behavioral adaptations to error and conflict. Several key findings emerged 1) we replicated previous behavioral findings showing slowing in reaction time (RT) after error and conflict; 2) consistent with previous literature, more ventral/anterior portions of the ACC were sensitive to error versus more dorsal/posterior regions sensitive to conflict; 3) regions outside the ACC showed similar distinctions, with error-related activity in ventral regions, and conflict activity more dorsally and superiorly to error-sensitive regions; and 4) in contrast to previous findings, a greater difference in ACC activity between correct and incorrect trials was associated with a smaller difference in RT between incorrect and correct trials. Taken together, our results suggest qualitative differences in the mechanisms supporting the up-regulation of control due to error or conflict, and line up with the hypothesis that posterior and dorsal regions may be involved in the initiation or selection of action sets, while more rostral portions may prepare control systems for task demands.

C66

WITHIN-TRIAL DISSOCIATION OF ERROR INHIBITION AND VOLITIONAL RESPONSE INHIBITION IN A PATIENT WITH DAMAGE TO THE RIGHT INFERIOR FRONTAL GYRUS

Avinash Vaidya[1], Eldad Hochman[1], Lesley Fellows[1]; [1]Montreal Neurological Institute, Department of Neurology and Neurosurgery, McGill University — Recent evidence indicates the existence of a right lateralized network involved in inhibitory control, though the conditions that engage this network have yet to be fully specified. Lesion and activation studies have implicated the right inferior frontal gyrus (rIFG) in performance of the stop-signal task. Although this task is intended to measure volitional response inhibition, inhibition is confounded with the need to attend to the stop signal. We tested a participant with damage to the rIFG and eight healthy controls in a task that demanded volitional response inhibition cued by error detection, rather than an external stop signal. We also measured 'automatic' error inhibition, indexed by the time taken to lift the finger committing an error compared to the lifting time for correct responses. Participants completed a speeded flanker task with alternating blocks requiring them either to correct their errors or inhibit 'automatic' corrections. The patient with rIFG damage was slow to volitionally inhibit corrective responses: in the first half of the experiment, she failed to inhibit automatic corrections. Subsequently, she was able to improve the frequency of successful inhibitions to control levels, but only by slowing her corrective responses. However, she was able to inhibit the erroneous response itself. Thus, within a single trial she demonstrated the intact ability to inhibit an on-going error, but a degraded ability to volitionally inhibit the subsequent correction. This helps to specify the conditions that engage rIFG-related response inhibition, indicating a critical role in rapid, volitional response inhibition, but not in inhibiting errors.

C67

THE ROLE OF FRONTO-STRIATAL SYNCHRONIZATION PROCESSES FOR RESPONSE INHIBITION: ERP PHASE-SYNCHRONIZATION ANALYSES IN PRE-MANIFEST HUNTINGTON'S DISEASE GENE MUTATION CARRIERS

Vanessa Ness[1], Michael Falkenstein[2], Carsten Saft[3], Christian Beste[1]; [1]Institute for Cognitive Neuroscience, Department of Biopsychology, Ruhr-University Bochum, Universitätsstrasse 150, D-44780 Bochum, Germany, [2]Leibniz Research Centre Dortmund, Aging and CNS Diseases, Germany, [3]Department of Neurology, Huntington Centre NRW, St. Josef Hospital, Ruhr-University Bochum, Germany — Fronto-striatal loops play an important role in action selection processes, especially when discordant sensory and contextual information has to be integrated for adequate selection of actions. Neurodegeneration weakens neural inter-connectivity, compromising the precision of neural synchronization processes. Yet, it is widely unknown how far changes in the precision of neural synchronization processes are induced by only slight dysfunctions of striatal neural inter-connectivity and in how far such slight changes may affect action selection processes. We investigated these processes in a sample of 25 pre-HDs and case-matched controls in a modified Go/Nogo task. Neural synchronization processes were assessed by means of phase-locking factors (PLFs) derived from event-related potentials (ERPs). The results show pre-HDs only encounter problems in response inhibition, when discordant contextual information and sensory input have to be integrated. While 'habitual' action selection is unaffected by changes in striatal structures influencing reliability of neural synchronization processes, efficient 'controlled' processes of action may closely dependent upon highly reliable neural synchronization processes. Neurophysiological analysis suggests especially pre-motor inhibition processes (Nogo-N2) are affected. This effect was most strongly reflected in a decline in the degree of phase-locking in the Nogo-N2 range. Deficits in pre-HDs may emerge as a consequence of phase-locking-behavioral decoupling. Of clinical interest, declines in the precision of phase-locking depended on the amount of the individual's mutant huntingtin exposure, predicting the probability of disease manifestation in the next five years. This suggests phase-locking parameters may prove useful in future studies evaluating a possible function as a biomarker in Huntington's disease.

EXECUTIVE PROCESSES: Other

C68

THE FEEDBACK-RELATED NEGATIVITY AND EXECUTIVE FUNCTION IN ADOLESCENTS

Tina Zottoli[1,2,3], Jill Grose-Fifer[1,2]; [1]John Jay College of Criminal Justice, [2]City University of NY, Graduate Center, [3]St. Joseph's College of NY — Increased risk taking in adolescence may be due, in part, to immature incentive processing. Age related differences have already been reported for the feedback related negativity (FRN), an ERP component generated in the Anterior Cingulate (AC) and thought to reflect the motivational significance of external feedback. However, the relationship of the FRN to observable behavior has not been well established. For this study, we recorded the FRN in adolescent and young adult males as they performed a gambling task involving unpredictable monetary losses and gains of low and high magnitude. The amplitude and latency of the FRN were examined in relation to performance on two executive function measures that rely on feedback processing and are known to activate AC: the Wisconsin Card Sorting Task (WCST) and the Iowa Gambling Task (IGT). In adolescents, smaller FRN amplitude after

losses was related to slower learning on the WCST and longer latency of the FRN after high magnitude losses was predictive of poorer performance on the IGT. In contrast, there was no relationship between the FRN and task performance in adults. Importantly, neither the variability in task scores, nor in the physiological measures differed significantly between groups. These findings suggest that the FRN is more directly tied to observable behavior in teenagers than in adults. We suggest that this may be due to the presence of more mature prefrontal systems in adults which exert stronger top-down modulation on behavior, whereas adolescent behavior may be driven by more bottom-up processes, reflected in the FRN.

C69

CHRONIC METHAMPHETAMINE ALTERS MULTIPLE DOMAINS OF COGNITIVE FUNCTION Sarine S. Janetsian[1], Maureen M. Timm[1], Brianna M. Todd[1], Christopher C. Lapish[1,2,3]; [1]IUPUI Department of Psychology, [2]IUSOM Stark Neuroscience Institute, [3]IUPUI School of Science Institute for Mathematical Modeling and Computational Sciences — Repeated intermittent injections of methamphetamine (MA) yield protracted changes in neurophysiology and behavior, which have been shown to effectively model a number of the behavioral and cognitive abnormalities observed in addiction. In the current studies, sensitization was induced in Sprague-Dawley rats (5 mg/kg MA for 7/14 days) and multiple domains of cognition were assessed. Locomotor activity and stereotyped behavior were used as an index of behavioral sensitization. MA-treated animals initially exhibited a robust increase in locomotion that transitioned to stereotypy as the induction phase progressed. 25 days after the induction phase, cognition was assessed. In an operant attentional set-shifting task, there were no group differences in trials to criteria during the visual-cue discrimination component. During the extra-dimensional shift, MA-treated rats made significantly fewer errors compared to saline treated rats. However during the intra-dimensional shift, MA-treated rats made significantly more errors than saline-treated rats. Impairments in TOR, but not novel-object recognition, were also observed in MA-treated rats. Finally, no differences in social interaction were observed between groups. Collectively, these data provide further evidence that repeated intermittent exposure to MA differentially alters various cognitive domains and likely the neural systems that mediate them. Future studies will explore how neural systems necessary for the performance of these behaviors are altered in MA-treated animals and assess strategies to remediate these cognitive pathologies.

C70

THE LONG TERM INFLUENCE OF CONCUSSION ON YOUNG ADULTS' COGNITION Robert D. Moore[1], Steven P. Broglio[2], Kelly M. Brander[1], Vita F. Wu[1], Charles H. Hillman[1]; [1]University of Illinois Urbana-Champaign, [2]University of Michigan Ann-Arbor — Recently, increasing attention has been paid to the deleterious effects of sport-related mild traumatic brain injury (mtbi/concussion) on cognitive health and function. The aim of the current research was to evaluate the influence of mTBI incurred during early life on young adults' (mean age=22.1, ±2.4 at time of testing) cognitive function. Forty young adults were bifurcated into groups according to concussive history (0, 1+). Participants incurred all injuries during sport and recreation prior to the age of 18 and were an average of 7.1 years from last injury. All participants completed a 3-stimulus visual oddball task, a numerical switch task, and a modified flanker task during which ERP and behavioral measures were measured. Analysis revealed a significant group difference in response accuracy during the flanker task, with decreased accuracy for previously concussed participants. Further, participants with a history of concussion exhibited decreased P3 amplitudes compared to control participants during each of the cognitive tasks. The current findings suggest that individuals with a concussive history may demonstrate persistent decrements in neurocognitive function, including the allocation of attentional resources. While behavioral and neuroelectric differences were observed during the flanker task, neuroelectric differences in the switch and 3-stimulus oddball task exist in the absence of behavioral differences, suggesting that the neuroelectric system may be more sensitive than traditional behavioral measures to persistent and selective decrements resulting from concussion.

C71

ERP CORRELATES OF MALINGERED EXECUTIVE DYSFUNCTION Steven Hoover[1], Jill Grose-Fifer[1,2]; [1]The Graduate Center, CUNY, [2]John Jay College of Criminal Justice — Measures designed to assess malingering have become an integral part of many neuropsychological evaluations. However, behavioral malingering measures have been demonstrated to be vulnerable to both manipulation and coaching. Consequently, recent research has attempted to identify physiological indices of cognitive functioning that are less susceptible to overt manipulation. Previous physiological studies have focused on assessing the validity of an individual's memory impairment; however, the current study evaluates the effectiveness of a potential physiological measure of malingered executive dysfunction. Specifically, this study evaluated whether the P3a ERP component, which has been shown to be highly correlated with overall executive functioning, is resilient to intentional manipulation. ERPs were recorded using a three stimulus (standard, target, distracter) auditory oddball design, in order to compare differences in neural responses in participants simulating the executive functioning deficits associated with traumatic brain injury (TBI), and controls. Results demonstrated that in the malingering group, the amplitude, timing, and scalp distribution of the P3a elicited by the distracter stimuli was not significantly different from that in control participants, and did not demonstrate any of the characteristics reported in prior studies with TBI patients. Not only were malingerers unable to produce significant change in their basic orienting response (P3a), but the very process of attempting to employ additional strategies produced other physiological markers of deception, in terms of the timing and scalp distribution of the P3b to the target stimuli. This methodology shows promise for differentiating between malingerers and those with genuine brain injury.

C72

EXECUTIVE CONTROL IN LARGE SCALE SEARCH Kate, A. Longstaffe[1], Iain, D. Gilchrist[1], Bruce, M. Hood[1]; [1]University of Bristol — Humans live in a distracting and demanding world in which efficient search is a fundamental skill. In the past, computer-based experiments have been conducted to investigate the cognitive mechanisms that allow individuals to remember where they have been, decide where to search next, and control perceptual salience while searching. These skills can be defined by three executive sub-processes: working memory, inhibition and attention. In our studies, we investigate these processes while adult participants search within a large environment. The search environment contained search locations on the floor which were illuminated green. The target location was discovered when pressing the switch at a location turned the green light red. The perceptual salience of search locations was manipulated by having some lights flashing and some static. Participants were more likely to search at the flashing locations, even when explicitly informed that the target was equally likely to be located at any location. This effect was robust; present in all participants, across all trials. Participants' attention was captured by the perceptual salience of flashing lights and they were unable to inhibit preference for them. This inability to inhibit attending to repeated salient events represents a failure of executive function. Participants were however able to remember previously visited locations and avoid revisits, showing a functioning spatial working memory. This suggests that individual executive sub-processes play different roles during large scale search.

C73

SHARED USE OF NEURAL RESOURCES BETWEEN FINGER TAPPING AND ADDITION Firat Soylu[1], Sharlene Newman[1]; [1]Indiana University, Bloomington — Recent advances in the study of embodied cognition have yielded to a new interest in how mathematical thinking relates to our body and the sensorimotor system. One of the main claims in the embodied cognition perspective is that mathematical processes are

grounded in the sensorimotor system, i.e., sensorimotor processes share neural resources with mathematical processes. In this study, we explore one instance of this claim by investigating the neural overlap between arithmetic and finger tapping. In a previous behavioral dual-task study we showed that finger tapping interferes more with addition compared to a control sentence comprehension task (Soylu & Newman, 2011). Based on this study, we investigated the overlapping neural resources between addition and finger tapping, and studied the effects of tapping and addition difficulty, using a dual-task fMRI paradigm. Results revealed that neural correlates of addition overlaps with a frontoparietal network that is also used by finger tapping. Angular gyrus was deactivated, compared to resting state, across all conditions. The deactivation was modulated by both addition and tapping difficulty. We also found evidence for angular and supramarginal gyri having different functional contributions to arithmetic processing. Based on the results we inferred that bilateral angular gyri participate in mental representation of fingers where left supramarginal gyrus mediates sequential activation of finger representations, such as it is the case in finger tapping. Overall the results further our understanding of shared use of neural resources between arithmetic and the sensorimotor system, and makes a strong case for embodiment of arithmetic.

C74

PHENOMENOLOGY OF THE STREAM OF CONSCIOUSNESS: INTROSPECTIONS ABOUT THOUGHTS AND THE INTERNAL OBSERVER

Christine A. Godwin[1], Allison McBride[1], Carlos Montemayor[1], Mark W. Geisler[1], Ezequiel Morsella[1,2]; [1]San Francisco State University, [2]University of California, San Francisco — Building on research on mind wandering and its neural correlates (e.g., the Default Mode Network; Raichle et al., 2001), we examined the phenomenology of the stream of consciousness using new paradigms amenable to psychophysiological methods. In Study 1, participants (n = 29) self-reported what they believed to be the origins of spontaneously experienced thoughts. While performing a 9-min concentration exercise requiring one to focus on one's breathing, participants, when they experienced spontaneous cognitions, were asked to count the number of thoughts/percepts ('links') they believed led to each spontaneous thought. Participants reported 1.58 links per thought (SEM = .23); a second group of participants (n = 74) indicated which thoughts were triggered by stimuli in their immediate, external environment (M = 53%, SEM = .54). With a variant of this paradigm, we began examining the electroencephalogram (EEG) correlates of our link measures. Study 2 examined the perceived stability of the "observing self" of the stream of consciousness. During 30-sec trials, participants (n= 26) observed ambiguous (e.g., Necker cube) or unambiguous figures (e.g., 12 dots) and pressed a button whenever they sensed a change in themselves or in the stimulus. Compared to either kind of figure (mean changes = 2.8, SEM = .42 and M = 1.6, SEM = .09, respectively), participants reported that the self was more unchanging (M = 1.2, SEM = .07), $F(16) = 17.92$, $p = .0006$. The aim of these new paradigms is to elucidate the neural correlates of these distinct aspects of the stream of consciousness.

C75

ELECTROPHYSIOLOGICAL RESPONSES OF SPEED-ACCURACY TRADE-OFF ON A CONTINUOUS PERFORMANCE TASK IN NON-CLINICAL CHILDREN

Kazufumi Omura[1], Eriko Suzuki[1], Katsuhito Yamaguchi[1], Kenji Kusumoto[1]; [1]Yamagata University — It is suggested that the amplitude and latency of electrophysiological components of event-related potentials (ERPs) have been modulated by several factors, such as physical parameters of stimuli and instructions for response execution. The effects of speed instruction and the effects of accuracy instruction have been discussed in the sensitivity of P3 latency reflecting stimulus–processing. However, there is not much evidence that speed-accuracy trade-off affects on electrophysiological responses. This study investigated how these instructional differences affect on the N2 and P3 components in a continuous performance task (CPT). Seven healthy children were asked to perform an AX-type CPT with EEG recording. They had a mean age of 10.40 (S.D.: 0.89) years. Participants were instructed to press a button as fast or accurate as possible, whenever the letter "9" was preceded by the letter "1" (Go condition). For all other letters following the letter "1", the prepared motor response had to be suppressed (Nogo condition). Two instructions were prepared, (1) emphasizing speed over accuracy, and (2) emphasizing accuracy over speed. Each instruction was counter-balanced. The results showed no clear differences of the amplitude and latency of the N2 and P3 in the both conditions between the speed and accuracy instructions. In contrast, the behavioral reaction time of the speed instruction was significantly faster than that of the accuracy instruction. The results suggest the strategy emphasizing speed over accuracy includes accurate response to the stimuli at the elementary school level. Future research needs to increase number of participants for the detailed investigation.

EXECUTIVE PROCESSES: Working memory

C76

DISTINCT NEURAL CORRELATES OF ASSOCIATIVE WORKING MEMORY AND LONG-TERM MEMORY DURING MAINTENANCE AND PROBE PHASE

Sarah Beul[1], Heiko Bergmann[1], Mark Rijpkema[1,2], Guillén Fernández[1,2], Roy P.C. Kessels[1,3]; [1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, [2]Radboud University Nijmegen Medical Centre, Department for Cognitive Neuroscience, [3]Radboud University Nijmegen Medical Centre, Department of Medical Psychology — An increasing number of neuroimaging and lesion studies show hippocampal involvement, not only in long-term memory (LTM) but also in working-memory (WM) tasks. However, this hippocampal involvement could reflect incidental LTM encoding. To disentangle WM processing and LTM formation we administered a delayed-match-to-sample associative WM task in an fMRI study. In each trial of this WM task, four face-house pairs had to be remembered and maintained during a delay of 7-13s. This was followed by a one-pair-probe phase; participants had to indicate whether it matched one of the presented pairs. Subsequently, an unexpected recognition-memory (LTM) task was administered. Hence, maintenance- and retrieval-related activity predicting WM success in the absence of successful LTM formation was isolated. Data acquisition is completed but here we report initial whole-brain analyses (?=.001, contiguous voxels > 60) of the first 17 participants for the WM contrasts only. During the late-delay period, elevated activation was observed in the precuneus and in the right insula. During the probe phase increased activation for WM hits vs. misses was found in left and right superior temporal sulcus, right middle temporal gyrus, posterior cingulate gyrus (PCiG), precuneus, and ventro-medial pre-frontal cortex (VMPFC), which even survived a FWE cluster correction. Particularly these latter three areas have previously been reported to be active during the retrieval phase, reflecting visual processing / imagery in the absence of external visual stimulation (PCiG, precuneus) and strategic retrieval processes (VMPFC), respectively. Additional analyses will be presented, also focusing on LTM contrasts and the medial temporal lobe.

C77

THE LEFT TPJ IN NOVELTY DETECTION AND VERBAL WORKING MEMORY: IS STIMULUS-DRIVEN ATTENTION THE COMMON FACTOR?

Susan Ravizza[1], Jennifer Van Loon[1], Jonathan Hakun[1], David Zhu[1]; [1]Michigan State University — Bilateral activation of the temporoparietal junction (TPJ) is reported during novelty detection tasks in which stimuli appear infrequently (c.f., Kiehl et al., 2001, 2005; Laurens et al., 2005; Wolf et al., 2008). In addition, the left TPJ is active during the encoding and retrieval stages of a verbal working memory task (Ravizza et al., 2011). This pattern of activity across studies suggests a role of the left TPJ in stimulus-driven attention that is critical in performance for both novelty detection and stimulus encoding. The goal of the current study was to determine whether the same region of the left TPJ was active in both verbal working memory and novelty detection tasks as assessed within the same individuals. In an fMRI study, participants completed a visual novelty

detection task using verbal and non-verbal stimuli as well as a serial-recognition task in which a temporal jitter (200-1000ms) was induced during the encoding phase. Novelty detection and verbal encoding recruited overlapping regions of the left TPJ. These findings demonstrate the importance of stimulus-driven attention in memory encoding and support a functional role of the left TPJ in stimulus-driven attention.

C78

MEMORY TRAINING FACILITATES MOTOR LEARNING IN YOUNG AND OLDER ADULTS John S.Y. Chan[1], Jin H. Yan[2]; [1]The Chinese University of Hong Kong, [2]The Shanghai University of Sport — Procedural skills and working memory are functionally related. The effect of practice on working memory is promising. We examined the benefits of computerized visuospatial working memory training for the accuracy of sequential finger movements in both older (n = 20, M = 70.6 years) and young adults (n = 20, M = 21.1 years). Participants in each age group were randomly assigned to the experimental and control groups. Baseline performance of 2-, 3-, 4-, 5-back numerical and spatial tasks, and the retention of the 4-, 8-, 12-, 16-element sequences were evaluated. After the pretests, for one hour each day over 10 consecutive days, the participants in the experimental group practiced an adaptive version of n-back spatial task while those in the control group practiced the non-adaptive version. The baseline tests were given to all participants in the posttest. Results showed faster reaction times for both numerical and spatial n-back tasks in all participants. Spatial accuracy increased in both age groups. Performance in numerical n-back tasks remained unchanged. Young adults showed significant improvements in the retention of the 12- and 16-element sequences. The improvements in the 4- and 8-element sequences were insignificant. Ceiling effects of the simple tasks explain the performance of young adults. More importantly, older learners improved the accuracy of motor sequences in all conditions. The results support our hypothesis that computerized working memory training improves procedural motor learning, especially for older learners.

C79

COGNITIVE SEQUELAE OF TBI FOR YOUNG ADULTS George Spilich[1], Lauren Littlefield[1], Katherine Leekley[1]; [1]Washington College, Chestertown, MD — This study was designed to investigate the effects of concussions on the working memory (WM) and attentional performance of young adults, skills that are essential for success in college and in life. Participants were tested on two working memory tasks: the Sternberg scanning task and the Shepard-Metzler mental rotation task, and also the TOVA, a neuropsychological test of sustained and selective attention. Participants were 82 college students; 40 were non-concussed controls and 42 were individuals who self-reported having had at least one concussion in the last 5 years. Controls were significantly faster at verbal and visuospatial WM processing than the concussed participants on both WM tasks. The comparison of the performance of concussed and non-concussed individuals on the TOVA showed that concussed individuals demonstrated significantly greater RT variability, as well as significantly greater commission/false alarms and significantly lower d' which suggests difficulty differentiating targets from non-targets. The TOVA results are indicative of a meaningful attentional deficit. WM and TOVA deficits were greatest for those individuals who had 3 or more concussions, while individuals with 2 or less were relatively unaffected. Finally, the objective and subjective impact of these episodes upon cognitive performance lasted longer than 6 months for the 3 and over concussion individuals.

C80

A META-ANALYSIS OF EXECUTIVE COMPONENTS OF WORKING MEMORY Derek Nee[1,2], Joshua Brown[1], Mary Askren[2,3], Marc Berman[4], Emre Demiralp[2], Adam Krawitz[5], John Jonides[2]; [1]Indiana University, [2]University of Michigan, [3]University of Washington, [4]Rotman Research Institute, [5]University of Victoria — Working memory (WM) enables the online maintenance and manipulation of information and is central to intelligent cognitive functioning. Much research has investigated executive processes of WM in order to understand the operations that make WM "work". However, there is yet little consensus regarding how executive processes of WM are organized. Here, we used quantitative meta-analysis to summarize data from 36 experiments that examined executive processes of WM. Experiments were categorized into four component functions central to WM: protecting WM from external distraction (distractor resistance), preventing irrelevant memories from intruding into WM (intrusion resistance), shifting attention within WM (shifting), and updating the contents of WM (updating). Data were also sorted by content (verbal, spatial, object). Meta-analytic results suggested that rather than dissociating into distinct functions, two separate frontal regions were recruited across diverse executive demands. One region was located dorsally in the caudal superior frontal sulcus (SFS) and was especially sensitive to spatial content. The other was located laterally in the mid-lateral prefrontal cortex (PFC) and showed sensitivity to non-spatial content. We propose that dorsal-"where"/ventral-"what" frameworks that have been applied to WM maintenance also apply to executive processes of WM. Hence, WM can largely be simplified to a dual selection model.

C81

ACCESS TO LINGUISTIC STRUCTURE ENHANCES VISUOSPATIAL WORKING MEMORY CAPACITY Mary Rudner[1], Eleni Orfanidou[2,3], Cheryl Capek[4], Velia Cardin[2], Bencie Woll[2], Jerker Rönnberg[1]; [1]Linköping University, [2]University College London, [3]University of Crete, [4]University of Manchester — Verbal and visuospatial working memory (WM) have been widely studied but little is known about linguistic versus non-linguistic WM in the visuospatial domain. Sign languages (SL) are visuospatial languages that have a neurocognitive representation in deaf people similar to that of speech-based languages in hearing people. Thus SL can be used to study linguistic WM in the visuospatial domain. In the present study, SL stimuli were used as linguistic stimuli for signers and non-linguistic stimuli for non-signers to investigate how access to semantic and phonological representations of SL influences visuospatial WM. Materials were videos of a deaf signer modeling three types of sign-based stimuli and matched non-linguistic stimuli. 25 deaf native signers (DS) took part along with 25 hearing non-signers (HN) who could not access any linguistic content of the material. Sign-based stimuli were familiar signs (semantic and phonological content), unfamiliar signs (phonological but no semantic content) and non-signs (illegal combinations of phonological components with no semantic content). All participants performed 2-back WM tasks, targeting either the identity (visual aspect) or location (spatial aspect) of the stimuli, with all four materials. In the identity task DS performed better than HN with sign-based materials but did not gain extra benefit from semantic or phonological content. In the location task DS benefited from semantic but not phonological content. These results show that signers can use linguistic knowledge in visuospatial WM tasks. Specifically, access to phonological components (sign-based material) supports identity processing and semantic content (familiar signs) supports location processing in visuospatial WM.

C82

PATTERN CLASSIFICATION OF ERPS PREDICTS INDIVIDUAL DIFFERENCES IN READING COMPREHENSION Julia Mossbridge[1], Marcia Grabowecky[1], Satoru Suzuki[1]; [1]Northwestern University — We investigated whether pattern classification of event-related potentials (ERPs) can provide insight into individual differences in reading comprehension. We visually presented an excerpt from a novel, one word at a time (rate=2 Hz), and analyzed ERPs to a target function word ("and") in two conditions. In the ordered condition, participants followed the story in anticipation of a subsequent comprehension test and pressed a key whenever they saw "and." In the scrambled condition, participants performed only the latter task and the words were presented in a randomized order. The rationale was that "and" would be processed differently when participants attempted to comprehend the story in the ordered (dual-task) condition versus the scrambled (single-task) condition, and that ERP correlates of this difference might predict individual differences in reading comprehension. Across all participants (N=28), a target-

induced positivity at frontal electrodes peaking at 400-500 ms was significantly smaller in the ordered than the scrambled condition. We next determined whether target difference waves (ERPs to "and" in the ordered minus scrambled condition) could differentiate good comprehenders (above median comprehension score) from poor comprehenders (below median). To this end, we used a random-forest classification method to determine whether a specific spatio-temporal ERP pattern reliably classified good/poor comprehenders. ERPs from right-frontal electrodes at 400-500 ms reliably predicted comprehension (90% correct classification at $p<0.00005$ by chi-squared test; confirmed by classification of the same data but with randomized labels for comprehension ability). Our results thus suggest that right-frontal mechanisms, potentially related to working memory, contribute to reading comprehension.

C83

VISUAL AND SPATIAL COMPONENTS OF VISUAL WORKING MEMORY REPRESENTATIONS: AN ERP STUDY Federica Meconi[1], Paola Sessa[1]; [1]University of Padova — We investigated the contribution of visual and spatial working memory (WM) subsystems in building a visual WM representation. To this aim we tested 15 participants in a color-change detection task by monitoring an electrophysiological marker of visual WM capacity: The Sustained Posterior Contralateral Negativity (SPCN). We compared two spatial arrangements of 2, 4 and 6 colored squares: 1. randomly positioned on a visual display or 2. organized in accordance with the Gestalt grouping principle of proximity. Behavioral results showed no significant differences between the two spatial arrangements. Notably, when compared the same number of stimuli, electrophysiological results showed larger SPCN amplitude in the random arrangement than in the organized arrangement. In addition, no significant interaction between spatial arrangement and the number of stimuli was observed. These data support the independence of the two distinct WM subsystems in building a visual WM representation.

C84

DYNAMIC CHANGES IN NEURONAL NETWORK ARCHITECTURE DURING WORKING MEMORY TASK Felix Siebenhuehner[1], Danielle S. Bassett[1], Richard Coppola[2], Daniel R. Weinberger[2]; [1]Department of Physics, University of California, Santa Barbara, [2]Clinical Brain Disorders Branch, National Institute of Mental Health, Bethesda — Oscillatory brain activity synchronized over an extended network of cortical areas is associated with a variety of cognitive processes crucial for working memory performance. Recent work suggests that changes in network organization underlie changes in complex behaviors such as learning. We investigate temporal changes and variation across individuals in whole-brain functional network structure during a 2-back working memory task using MEG data in healthy subjects. Sensor time series were decomposed into frequency bands of interest using a wavelet transform and functional brain networks were constructed from each of 66 trials by computing the mutual information between wavelet coefficients of all pairs of sensors. Using a battery of network properties, we examine the temporal variability in network architecture and identify metrics that reliably measure subject-specific activity. Our analysis shows that the brain's network organization in short-term working memory changes substantially over time and between individuals. We observe that qualitatively distinct patterns of network organization characterize subgroups of the population. For most metrics, the variability over subjects was greater than the variability over trials within subjects, indicating that network structure is a robust and reliable measurement of subject-specific brain function. Our work demonstrates that functional network architecture differs meaningfully across individuals and shows a degree of temporal variability that suggests it might be associated with task behavior. More specifically, our work provides important insights into specific network organizational properties that may be signatures of short-term behavioral variables such as task accuracy.

C85

BEHAVIORAL AND EEG EFFECTS OF WORKING MEMORY TRAINING Bornali Kundu[1], David W. Sutterer[1], Bradley R. Postle[1]; [1]University of Wisconsin - Madison — Training on working memory tasks can improve performance on that task, an effect that can also generalize to other domains. In this study, we tested the idea that plasticity underlies training-related improvement by testing for changes in brain function pre- and post-training. Prior to training, we collected a battery of neural and psychometric measures encompassing working memory, selective attention, and interference control, then divided subjects into experimental (n=8) and control (n=8) groups. The experimental group trained on an adaptive n-back task for 40 minutes per day, 5 times per week, for 5 weeks. The control group trained on an adaptive task without overt memory demands (Tetris). All subjects showed training-related improvement on their training task. The experimental group also showed greater improvement in working memory capacity (determined from performance on a change-detection task; mean K-value for experimental group pre-training=2.25, post-training=2.62; for control group pre-training=2.31, post-training=2.40), as well as in spatial delayed-recognition performance (mean change in percent accuracy from pre- to post-training for experimental group +3.5%, for control group +0.5%). These behavioral effects were paralleled by post- vs. pre-training increase in the magnitude of contralateral delayed activity (CDA), recorded during a change-detection task (experimental group only). Interestingly, the control group showed greater improvement than the experimental group on the Operation Span task, the Stroop task, and a guided visual search task. These results illustrate how training can be used to reveal overlapping versus distinct mechanisms underlying performance on seemingly related cognitive tasks.

LANGUAGE: Development & aging

C86

GESTURAL EFFECTS ON LANGUAGE LEARNING IN YOUNG CHILDREN WITH AUTISM SPECTRUM DISORDER Tracey A. Knaus[1], Jodi Kamps[2], Anne L. Foundas[1]; [1]Louisiana State University Health Sciences Center - New Orleans, [2]Children's Hospital - New Orleans — Autism spectrum disorder (ASD) is a neurodevelopmental disorder which involves deficits in social functions and language and communication, accompanied by repetitive behaviors or restricted or unusual interests. The development of action semantics (tool use and communicative gestures) facilitates the development of language (linguistic semantics and speech output) in typically developing individuals. Seeing gestures has been shown to affect how language is processed. Although previous studies in ASD have demonstrated impaired gesture production, few studies have examined gesture comprehension (action semantics) and its effects on language in ASD. The purpose of this study was to determine whether young children with ASD can use gestural information to learn new words. Subjects included 9 young boys with ASD, 3-6 years old. There were 2 conditions, a gesture condition and a control (no gesture) condition. During both conditions 2 toys were presented with each toy performing a different action. During the control condition, each toy was presented with a made-up action word; during the gesture condition an associated gesture was presented with a made-up action word. One of the toys was then requested, using the made-up word. All ASD boys performed above chance for the control condition (most at 100%). During the gesture condition, however, only 3 of 9 (33%) performed above chance. Results indicate that young children with ASD have difficulty using gestural information to assist with language learning. This differs from typically developing children, providing support for the hypothesis that the development of action semantics may be disrupted in ASD.

C87

AUDITORY PROCESSING OF GRAMMATICAL GENDER: AN ERP STUDY ON TURKISH-DUTCH BILINGUALS Bregtje J. Seton[1,2], Hanneke Loerts[1,2], Monika S. Schmid[1], Laurie A. Stowe[1,2]; [1]University of Groningen, the Netherlands, [2]University Medical Center Groningen — While Turkish does not have grammatical gender, the Dutch language has a rather opaque system of a common and a neuter gender that is visible on definite determiners and on adjectival inflections in indefinite noun phrases. Previous studies on grammatical gender processing in bilinguals investigate late L2 acquirers and used visual presentation of stimuli. In the present study, we were interested in early bilinguals and auditory processing of gender violations. We used event-related potentials (ERPs) to compare early bilingual Turkish-Dutch adults (Age of Acquisition < 3 yrs) to an age- and education matched native Dutch control group. Participants were presented with auditory sentences in Dutch, containing either correct or incorrect grammatical gender concord, followed by a grammaticality judgement task (GJT). The Turkish-Dutch bilinguals who scored highest on the GJT showed an ERP pattern which was similar to that of the Dutch control group, showing a positive peak in activation around 600 ms after the target onset (P600) for the gender violations, which was most pronounced on centro-posterior electrodes. The bilingual participants with the lowest accuracy rates on the GJT showed no difference between correct and incorrect sentences. These results imply that early acquisition and balanced use of the two languages are not necessarily predictors of native-like processing. In contrast, we propose that the large variation within the bilingual group could have originated in differences between quality of input and the amount of correct input.

C88

INFANTS SHOW INCREASED PHASE LOCKING OF OSCILLATORY BRAIN ACTIVITY IN THE THETA FREQUENCY BAND DURING SPEECH PERCEPTION Silvia Ortiz-Mantilla[1], Jarmo A Hämäläinen[1,2], April A Benasich[1]; [1]Rutgers, The State University of New Jersey, [2]University of Jyva?skyla?, Finland — Stimulus-induced modulation of cortical rhythms in the theta (4-8 Hz) and gamma (30-80 Hz) frequency bands during speech processing has been found in adults. However, very little is known about the frequency composition of infant event-related potentials (ERPs). Low frequency oscillations have been reported to be prominent in infant EEG, and it is hypothesized that low frequency oscillations also underlie infant ERP responses. One way to examine the frequencies within infant ERPs is inter-trial phase locking (ITPL). ITPL is a measure of how consistently the phase at different frequency bands locks to stimulation presented across trials. In this study, we examined ITPL of 6-month-olds in response to spoken syllables. Infants were given a passive oddball paradigm using a voice-onset time contrast within consonant-vowel syllables. Dense array EEG/ERP cortical signals were collected and mapped onto age-appropriate MRIs. Discrete dipole source models identified ERP generators in primary auditory cortex. Individual source models were then applied to each raw EEG recording in order to conduct time-frequency analyses. Repeated measures ANOVAs [Hemisphere (left, right temporal cortex) x Stimulus (standard, deviant) x frequency band (4, 6, 8, 10, 12 Hz)] contrasting baseline (-100 ms) and using a 150-250 ms post-stimulus time window revealed an increase in ITPL in the 4-8 Hz theta band, that was particularly prominent during deviant detection. Our results demonstrate that in a period critical for setting-up language, at least part of the infant auditory change detection response to speech signals can be attributed to alignment of low frequency brain oscillations.

C89

ELECTROPHYSIOLOGICAL MEASURES OF ATTENTION DURING SPEECH PERCEPTION PREDICT HIGHER-LEVEL VERBAL SKILLS IN CHILDREN Lori Astheimer[1], Monika Janus[1], Sylvain Moreno[2], Ellen Bialystok[1,2]; [1]York University, [2]Rotman Research Institute — Recent event-related potential (ERP) evidence demonstrates that preschool-aged children modulate attention over time during speech perception, selectively attending to informative moments such as word onsets. Although this observation provides additional support for a role of attention in language processing, it is unclear whether this type of attentional modulation reflects basic speech perception mechanisms, higher-level language skills, or more general cognitive abilities. The current study examined these potential relationships by measuring ERPs from 5-year-old children listening to a narrative containing attention probes presented at word onsets and random control times. Children also completed behavioral tests assessing verbal (receptive vocabulary, grammaticality judgment) and nonverbal (nonverbal intelligence, working memory) performance. Consistent with previous findings, probes presented at word onsets elicited a more negative ERP response beginning around 100 ms after probe onset than control probes, indicating increased attention to word-initial segments. Crucially, the magnitude of this difference was correlated with behavioral performance on verbal tasks, but showed no relationship to nonverbal measures. Within the language domain, ERP attention effects were most strongly correlated with performance on complex linguistic tasks as opposed to simpler measures of vocabulary or grammar. In particular, greater attention to word onsets was associated with better performance on grammaticality judgments of semantically anomalous sentences which require children to attend to syntactic structure while ignoring semantic violations. These results demonstrate that effective allocation of attention during speech perception supports higher-level language processing in children by allowing them to focus on relevant information at both individual word and complex sentence levels.

C90

MUSIC AND LANGUAGE SHORT-TERM TRAINING REVEAL BRAIN PLASTICITY IN EARLY CHILDHOOD Yunjo Lee[1], Monika Janus[2], Ellen Bialystok[1,2], Sylvain Moreno[1,3]; [1]Rotman Research Institute, Baycrest Centre, [2]York Unversity, [3]University of Toronto — Bilinguals and musicians have been shown to perform better than monolinguals in executive function, memory and working memory tasks. For bilinguals, these findings have been attributed to their need to manage attention to two languages that are jointly available during linguistic performance. For musicians, these findings have been attributed to their training requirements involving intensive memorization and motor coordination. To further explore these effects of experience, we conducted an intervention study testing the outcome of music vs second-language training to determine (1) whether training can change preattentive sound processing and (2) whether this change is domain-specific or not. We used a pre-test/post-test design with 53 English-speaking children, 4-5 year old, with no prior musical or second-language training. Groups were equated on age, IQ score and maternal education and received computer-based music or French language training for one month. Here, we report the results of ERP recordings of the mismatch negativity (MMN) while children were passively listening to music notes (A, A sharp) or French vowels (u, ou). After training, the music group showed an average of 34.8 ms shift in MMN latency, revealing faster sound processing in the music note condition but not in the French vowel condition. In contrast, the French group showed enhanced MMN amplitude only in the vowel condition, accompanied by brain reorganization revealing a bi-hemispheric pattern after training. These results show that a short period of music and second language training induced domain specific and domain general brain plasticity of sound processing in early childhood.

C91

ERP EVIDENCE FOR DIFFERENT SEQUENTIAL PATTERN-LEARNING MECHANISMS IN CHILDREN AND ADULTS Christopher Conway[1], Anne Walk[1], John Purdy[2], Gretchen Smith[1]; [1]Saint Louis University, [2]Purdue University — A long-held assumption in language acquisition is that there is a critical period for learning natural language (Lenneberg, 1967). To explore whether sensitive periods in language acquisition might be due to developmental constraints on more fundamental, domain-general learning abilities, we investigated the ERP correlates of implicit sequence learning in children (ages 8-10) and adults. In the learning phase of this artificial-grammar learning experiment (based on Conway et al., 2010),

children and adults used a touchscreen monitor to replicate rule-based sequences of visual-spatial patterns presented on the screen (each sequence consisted of flashing black squares that could appear in one of four different positions). Following experience with the structured patterns, participants then completed a test phase involving the reproduction of novel sequences, with half of the sequences following the grammatical rules, and half containing violations. ERP responses to rule violations differed between the children and adults: whereas the adults displayed a bilateral anterior positivity around 250-300ms (a P3a component), sometimes considered a reflection of the allocation of attention, the children displayed a left-lateralized positive deflection around 100ms. These findings provide electrophysiological evidence that in this sequential learning task, children utilized a learning mechanism that was different from that used by adults. It may be that the end of the critical period for natural language corresponds to a transition between two different types of domain-general learning mechanisms, with the left-lateralized component observed in children reflecting the kind of implicit, incidental learning so important for natural language acquisition.

C92

AGE-RELATED DIFFERENCES IN THE NEURAL BASES OF PHONOLOGICAL AND SEMANTIC PROCESSES Michele Diaz[1], Micah Johnson[1], C. Christine Camblin[1], Deborah Burke[2], David Madden[1]; [1]Duke University, [2]Pomona College — Within the domain of language, older adults demonstrate considerable preservation of semantic function compared to younger adults, but also impairments on several indices of phonological retrieval. This suggests a fundamental difference in the cognitive organization of these abilities. According to the Transmission Deficit Theory, this pattern may represent the effects of different levels of redundancy for semantic and phonological information. Healthy younger and older adults participated in an fMRI experiment (n=16 per group). Stimuli consisted of a cue followed by a pair of photographs that were semantically or phonologically related. The task was to decide whether both photographs matched the cue. Behavioral analyses of drift rate yielded a significant Group x Condition interaction, such that, for older adults, semantic retrieval was more efficient than phonological retrieval, whereas for younger adults, phonological retrieval was relatively more efficient. We defined regions selectively activated by either semantic or phonological retrieval ($p<.001$, corrected). In the semantic network, younger adults elicited greater activation than older adults in left posterior inferior temporal gyri and bilateral occipital gyri, independently of condition. In contrast, in the phonological network, activation was dependent on both age group and condition. Two clusters in the left hemisphere, inferior frontal/insula, and the anterior cingulate. For both clusters, older adults exhibited more activation in the phonological condition than in the semantic condition, whereas younger adults showed either the reverse pattern or no difference. These results support a differential decline for older adults on phonological, but not semantic retrieval, consistent with Transmission Deficit Theory.

C93

EXAMINING AT-RISK CLASSIFICATION FOR FUTURE READING DIFFICULTY IN KINDERGARTENERS Ola Ozernov-Palchik[1], Elizabeth S. Norton[2,3], Abigail B. Cyr[3], Sara D. Beach[3], Keri-Lee A. Garel[3], John D. E. Gabrieli[3,4], Nadine Gaab[1,5,6]; [1]Children's Hospital Boston; Developmental Medicine Center, [2]Center for Reading and Language Research, Department of Child Development, [3]Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, [4]Athinoula A. Martinos Imaging Center at the McGovern Institute for Brain Research, Massachusetts Institute of Technology, [5]Harvard Medical School, [6]Harvard Graduate School of Education — Developmental Dyslexia (DD) is characterized by difficulties with accurate/fluent word recognition and decoding. DD is typically diagnosed in 2nd or 3rd grade and affects 5-17% of the population. Several studies have examined behavioral pre-markers of DD in kindergarteners and have identified Letter Knowledge (LK), Phonemic Awareness (PA), and Rapid Automatized Naming (RAN) as the most reliable predictors of reading difficulty. However, behavioral measures alone have been somewhat ineffective at identifying children at-risk for dyslexia before reading acquisition, and two recent studies in a phonologically transparent orthography (German) have shown that brain measures in kindergarten can significantly add to the predictive value of behavioral measures. The goal of our study is to identify the best set of behavioral predictors for later reading outcome in English-speaking kindergartners and to determine whether brain measures (EEG/fMRI) can add any predictive value. To date, we have assessed 300 kindergarteners from 17 ethnically and socioeconomically-diverse schools. Each child completed a 45-minute screening battery including measures of PA, RAN and LK. Children with/without risk will complete MRI and EEG and be followed longitudinally. Preliminary results suggest great variability of risk classification between selected constructs . 7% of children were at risk based on PA, 2% on LK, 17.5% on RAN and 8% on multiple measures. Our study will determine which measures (behavioral, brain, or a combination) best predict a reading difficulty. Our results have significant implications for educational policy and may help to maximize the specificity and sensitivity of early identification of children at risk for DD.

PERCEPTION & ACTION: Audition

C94

EFFECTS OF SYNCHRONIZATION, RHYTHM, AND MELODY ON APHASICS' PRODUCTIONS Pascale Lidji[1,2], Caroline Palmer[1], Michele Morningstar[1], Isabelle Peretz[2]; [1]McGill University, [2]Brams, University of Montreal — Studies suggest that choral singing or coordinating with rhythmic stimuli have beneficial effects on clinical conditions such as stuttering or aphasia. However, it is unclear whether these effects arise from the temporal regularity of the rhythmic stimuli or from the synchronization task. To investigate whether the temporal regularity and / or the synchronization task cause the improvement in vocal production, we examined whether synchronizing with or repeating sentences of varying regularity facilitates non-fluent aphasics' vocal productions. Eight non-fluent aphasics were asked to either repeat or synchronize their speech or singing with sentences that had been recorded in 3 conditions: naturally spoken (spoken with a natural prosody), regularly spoken (every other syllable aligned with a metronome click that was not heard by the participants) and regularly sung (sung on a simple melody with a metronome). Overall, aphasic participants produced more correct syllables in the synchronization than in the repetition task. They did not produce more correct syllables in the song or the regular speech condition than in the natural speech condition. However, the number of metrical positions filled (the proportion of syllables produced in the correct temporal position, irrespective of syllable accuracy) was higher when participants were singing. Finally, participants filled more metrical positions on strong than on weak beats. These results suggest that synchronizing with an external speech stimulus improves the quality of aphasics' speech. Rhythm (strong and weak beats) and melody improve the quantity, but not the quality, of aphasics' speech.

LANGUAGE: Development & aging

C95

BRAIN STRUCTURE IN PRESCHOOL IS ASSOCIATED WITH LATER READING ABILITY Nadine Gaab[1,2,3], Michael Figgucio[1,4], Sarah Meissner[1,5], Nora Raschle[1,2]; [1]Children's Hospital Boston, [2]Harvard Medical School, [3]Harvard Graduate School of Education, [4]Boston University, [5]University of Konstanz, Germany — Developmental Dyslexia (DD) affects 5-17% of all children and is characterized by difficulties in word recognition and decoding. Various (f)MRI studies and meta-analysis have reported hypoactivation and reduced gray matter volume indices within left-hemispheric parietotemporal and occipitotemporal areas in adults and children with a diagnosis of DD (e.g.; Richlan et al., 2011). A few studies have linked functional brain measures in beginning readers to later reading ability (e.g. Maurer et al., 2009; Bach et al. 2011) but a link

between brain structure indices in preschool and later reading ability has not been established yet. The goal of this study was to investigate the relationship between gray matter volume in left-hemispheric parieto-temporal and occipitotemporal areas prior to reading onset and later reading ability. Whole brain T1-weighted MPRAGE structural scans were collected in 20 children with and without a family history of DD before (5.7y) and after (6.9y) one year of kindergarten. Standardized language scores were obtained before and after reading onset. Statistical analyses of gray matter volume were performed using voxel-based morphometry. Correlational analyses were employed to link gray matter volume indices prior to kindergarten to behavioral measures after reading onset. Our results show that gray matter volume indices in left-hemispheric temporoparietal/occipitotemporal brain regions obtained prior to reading onset correlate with reading skills (including Word and Letter ID and Passage Comprehension) after one year of kindergarten. Further research is needed to determine if brain structure indices may be utilized as early pre-markers of DD for the identification of children at risk.

C96

MMN RESPONSES IN ACQUIRED APRAXIA OF SPEECH: EVIDENCE FOR PHONOLOGICAL INVOLVEMENT Karen Froud[1], Reem Khamis-Dakwar[2], Melissa Randazzo[3], Felicidad Garcia[1]; [1]Teachers College, Columbia University, [2]Adelphi University, [3]NorthWestern Unversity — Acquired apraxia of speech (AOS) commonly co-occurs with Broca's, anomic, or unclassified aphasia. It is characterized by inconsistent articulation errors as well as abnormal speech prosody (Duffy, 2005; McNeil, Robin, & Schmidt, 2008). Two main theoretical approaches attempt to explain the nature of the speech disorder in AOS: it may be viewed as a motor speech planning disorder (e.g. Kent, 2000); or the speech disorder may be associated with an underlying phonological representation deficit, namely overspecification in the phonological domain (Dogil & Mayer, 1988; Dogil, Mayer, & Vollmer, 1996). To evaluate these hypotheses, we investigated auditory MMN responses from monolingual English-speaking adults with a primary diagnosis of moderate-severe AOS, and age-matched controls. All participants passed hearing screens. High density EEG (128 channels, Tucker, 1993) was recorded while participants listened to CV syllables presented in passive-listening oddball paradigms: phonemic (standard /ba/vs deviant /pa/), allophonic (/pha/vs. /pa/), and nonspeech (FM sounds). MMN was derived from high-density EEG recordings by averaging and subtraction of averaged standard responses from averaged deviant responses within each condition. For all participants, the non-speech condition resulted in MMN enhancement to deviant presentations, as did the phonemic speech sound contrast. For the AOS group only, MMN enhancement was also apparent in response to the allophonic contrast; however, a greater right-lateralized scalp distribution of the MMN was observed compared to controls, which likely indexes lesion-related functional redistribution. We propose that these preliminary findings are consistent with a view of AOS as a disorder affecting underlying phonological representations.

LONG-TERM MEMORY: Development & aging

C97

MUSICAL EXPERIENCE BUFFERS AGE-RELATED DECLINES IN FRONTALLY-MEDIATED PROCESSES DURING A NOVEL OBJECT MEMORY TASK. Brenda Hanna-Pladdy[1], Rebecca Lepping[2], Hyun Choi[2], Cary Savage[2]; [1]Emory University, [2]University of Kansas — Numerous studies have implicated under-recruitment of frontally-mediated processes required for memory as responsible for age-related declines. However, the presence of cognitive aging variability emphasizes the need to identify moderating factors that can enhance memory maintenance. Mounting evidence supports training-induced structural and functional changes in musicians, although it is unclear if these plastic changes can result in transfer to nonmusical cognitive functions sustained in advanced age. To this end, we evaluated healthy older amateur musicians (>10 years) and nonmusicians (n=24; m=68 years) during encoding and short delayed recognition (8 minutes following structural scanning) of multicolored fractal images with 6 bold fMRI sequences, and long delayed recognition (30 minutes) after scanning. Following encoding, where subjects were presented 48 novel object designs across 2 trials in a block design, subjects underwent an event-related fMRI session of immediate and short delay recognition trials. Results revealed that musicians had greater activations in left frontal regions than nonmusicians for correctly recognized images; while nonmusicians relied more heavily on right medial temporal and superior parietal regions. These findings imply that extended musical training can result in plastic changes that can enhance age-related frontally-mediated compensation and memory performance. Furthermore, results suggest that musicians may uniquely process non-verbal information through a highly developed left lateralized network common to musical material, skilled movements and auditory processing.

C98

THE EFFECTS OF AGENCY ON SEQUENTIAL MEMORY IN 3-YEAR-OLD CHILDREN: COMBINING BEHAVIOR AND EVENT-RELATED POTENTIALS Lauren Howard[1], Amanda L. Woodward[1], Tracy Riggins[2]; [1]University of Chicago, Chicago, [2]University of Maryland, College Park — Previous research has shown that agency is a central theme found in the verbal recall of narrative events in both adults and school-age children (e.g., Trabasso et al., 1992). However, the effect of agency on memory in young children remains unexplored due to their verbal limitations, and has lead to the erroneous assumption that young children have poor memory for social events. The current study sought to address this issue by exploring the effects of agency on memory in 3-year-old children (n=20). By using a form of deferred imitation coupled with an event-related potential (ERP) task, we explored social episodic memory in a non-verbal/behavioral manner. Specifically, children learned an action sequence via pictures with or without an agent present. Preliminary results suggest that children who viewed the agent had better memory (i.e., reconstructed more steps in the action sequence) after a delay than those that did not see the agent in the pictures ($p<.05$). Furthermore, those who viewed the agent also evidenced ERP episodic memory effects, present over midline leads, in the 350-550 ms and 650-900 ms time windows. Participants who did not view the agent in the demonstration pictures did not show any such ERP effects. Taken together, agency appears to increase memory for an event and these effects are apparent at both behavioral and neural levels.

C99

GRAY VERSUS WHITE MATTER DAMAGE ACROSS VERBAL MEMORY PERFORMANCE IN LATE LIFE DEPRESSION Rebecca Charlton[1], Melissa Lamar[1], Aifeng Zhang[1], Anand Kumar[1]; [1]University of Illinois at Chicago — Verbal memory deficits attributed to late life depression (LLD) may result from executive dysfunction that is more detrimental to list-learning than story-based recall. Despite these behavioral dissociations, few studies have investigated related neuroanatomical dissociations in verbal memory performance. We compared list-learning to story-based memory in 25 non-demented individuals with LLD (age~66.3+7.8) and 41 non-demented/non-depressed healthy controls (HC; age~67.6+5.3). Performance was correlated with grey matter volumes in frontal, temporal and parietal regions associated with verbal memory; tract-based spatial statistics (TBSS) explored associations between performance and white matter integrity on a voxel-by-voxel basis. Lower verbal memory performance was observed in LLD compared to HC, only during long-delay free recall on list-learning. No group differences were observed in regional grey matter volumes or on TBSS. Significant positive correlations were noted in the LLD group, between list-learning long-delay free recall and grey matter volumes of prefrontal, temporal and parietal regions - a network important for subjective organization (an aspect of executive function). No correlations between TBSS and memory performance were observed in either group. This study is the first to demonstrate neuroanatomical dissociations in verbal memory performance in LLD and provides structural evidence for the executive dysfunction

known to be detrimental to list-learning performance. While associations existed with gray matter structures, none were observed with white matter integrity. The majority of our LLD sample had life-long rather than late-onset depression, suggesting that grey matter changes may have greater effect on cognition in LLD whereas white matter changes may be more significant in late-onset LLD.

C100

DOPAMINE MODULATION OF LEARNING WITH IMMEDIATE VS. DELAYED FEEDBACK: EVIDENCE FROM PARKINSON'S DISEASE. Karin Foerde[1], Erin Kendall Braun[1], Daphna Shohamy[1]; [1]Columbia University, Department of Psychology — Multiple brain systems support learning and memory. Gradual feedback-driven learning depends on the basal ganglia (BG), and the importance of dopamine for learning in the BG is widely recognized, but emerging evidence suggests a critical role for dopamine in modulating the medial temporal lobes (MTL) as well. Pharmacological manipulations of dopamine have shown mixed results for learning that depends both on the BG and the MTL: increasing levels of dopamine can lead to impaired, unaffected, or even enhanced performance on learning and memory tasks. Thus, fundamental questions remain about the role of dopamine in modulating different kinds of learning. We addressed this question by testing individuals with Parkinson's disease either 'off' medication (low dopamine levels) or 'on' dopaminergic medication (high dopamine levels). Parkinson's patients, healthy age-matched adults, and young adults completed an associative learning task where response-contingent feedback was delivered either immediately or after a delay of seven seconds. We previously found with fMRI that learning from immediate feedback depends on the BG, whereas learning the same associations with delayed feedback is supported by the MTL. Healthy control participants learned equally from immediate and delayed feedback. However, Parkinson's disease patients exhibited a selective impairment when learning from immediate feedback, a deficit that was present in patients both on and off dopaminergic medication in contrast with previous reports of worse learning in patients tested on dopaminergic medication. The findings also and raise questions about the impact of dopamine modulation on multiple forms of learning.

C101

THE ROLE OF SPATIAL CONTEXT IN OBJECT RECOGNITION MEMORY: A DEVELOPMENTAL APPROACH Jamie Edgin[1], Spano Goffredina[1], Kevin Kawa[1], Lynn Nadel[1]; [1]University of Arizona — In Hayes, Nadel and Ryan (2007) adults had 10% poorer object recognition if objects were removed from a rich visual context between study and test. This effect (the "contextual shift decrement (CSD)") was robust across several conditions, suggesting that object-context binding was automatic. We examined this effect in typically developing children and in Down Syndrome (DS), a population with impaired medial temporal lobe (MTL) function. Children in both groups learned common objects in semantically congruent contexts or on a white background. At test five minutes later, objects remained in the learned context (scene or white background), or objects were removed from the learned context. Children had to determine if the object was seen before (i.e., old or new judgment). Three-year old children and children with DS showed the effect, but children between the ages of 4- 12 years did not. The CSD re-emerged after 13 years. The presence of a u-shaped trajectory in the development of context dependency suggests that the CSD might reflect different underlying mechanisms across the age range tested. Given the relative under-development of the MTL in young children and those with DS, context dependency in these groups may reflect the formation of unitized object-context representations, while more flexible object-context associative representations emerge as children develop.

C102

ASPECTS OF METABOLIC SYNDROME ACROSS THE LIFESPAN: IMPLICATIONS FOR BRAIN STRUCTURE AND FUNCTION Melissa Lamar[1], Rebecca Charlton[1], Laura Korthauer[1], Anand Kumar[1]; [1]Department of Psychiatry, University of Illinois at Chicago — Metabolic syndrome affects 45% of Americans age 60 years and older and increases the risk of cardiovascular disease in affected individuals. Metabolic syndrome consists of a constellation of risk factors including hypertension, hyperglycemia, hypertriglyceridemia, low high-density lipoprotein levels and abdominal obesity. It promotes cerebral white matter damage which negatively impact cognitive and affective functioning; whether this pattern of impairment exists across the lifespan is less clear. 173 participants (age~58.3+13.0; range=30-89) were grouped based on the number of metabolic syndrome criteria met and compared across measures of medical, behavioral and neuroanatomical variables. Groups did not differ on age, education, overall cognitive or depressive symptomatology. They differed on stroke risk profile and cumulative illness rating scales (all p-values>.01) with individuals meeting no criteria having lower scores across these indices than individuals meeting one, two or three criteria for metabolic syndrome (0<1=2=3). A similar pattern emerged for an estimate of full-scale IQ (0>1=2=3; p=.03). After controlling for IQ, only immediate recall for prose passages remained significantly different (0=1>2, p<.01; 0>3, p=.06). In a subset of older participants (n=59), between-groups differences emerged for depressive symptomatology (3>2=1=0, p=.01) and FLAIR-derived white matter hyperintensity volumes (2>1>0, p=.02). Results suggest that symptoms of metabolic syndrome across the lifespan negatively impact a similar pattern of medical, cognitive and neuroanatomical sequelae as that seen in older adults. Given the risk for dementia imposed by the presence of metabolic syndrome, individuals meeting even a few criteria for this syndrome regardless of age should be monitored and aggressively treated.

THINKING: Decision making

C103

NEURAL PREDICTORS OF RISKY BEHAVIOUR Annabel B. Losecaat Vermeer[1,2], Maarten A.S. Boksem[2,3], Alan G. Sanfey[1,2]; [1]Radboud University Nijmegen, Behavioural Science Institute, The Netherlands, [2]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, The Netherlands, [3]Erasmus University Rotterdam, Rotterdam School of Management, The Netherlands — In risky decision-making scenarios people are generally risk averse, however, when deciding in loss situations they often become risk-seeking. This preference reversal, often attributed to loss aversion, is termed the reflection effect (Tversky & Kahneman, 1981). This study explored the processes underlying the reflection effect by investigating risky decision-making following real losses and gains. Specifically, is there a neural mechanism that predicts the observed preference reversals for risky decisions following gains and losses? We predicted brain areas involved in both evaluating losses and in the subsequent adjustment in behaviour (e.g. anterior insula, inferior frontal gyrus, cingulate cortex) would be related to preference reversals. Participants (n=26) played a task while undergoing fMRI in which they experienced either small losses or small gains. Following each individual gain or loss, participants could choose a gamble that would either compensate for or double their loss (after an initial loss) or either double or eliminate their gain (after an initial gain). Results demonstrated behaviour predicted by the reflection effect; participants switched their risk preferences depending on the initial gain or loss. Moreover, this behaviour was reflected in enhanced activity in the anterior insula and inferior frontal gyrus. These results support a proposed role of these areas in adaptive behavioural control involving risky decisions and demonstrate that such behavioural control is strongly context dependent.

C104

EFFECTS OF ATYPICAL ANTIPSYCHOTIC MEDICATION ON REWARD LEARNING IN SCHIZOPHRENIA Catherine Insel[1], Jenna Reinen[1], Daphna Shohamy[1], Tor D. Wager[2], L. Fredrik Jarskog[3], Jochen Weber[1], Sergio Francis M. Zenisek[1], Edward E. Smith[1,4]; [1]Columbia University, [2]University of Colorado at Boulder, [3]University of North Carolina, [4]New York State Psychiatric Institute — Schizophrenia is associated with an abnormal dopamine system, and dopamine receptors are the primary target for pharmacological treatment. Dopamine is known to underlie reward processing in general, and recent studies reveal impairments in reward processing in both medicated and unmedicated patients with schizophrenia. These impairments may reflect, in part, dysfunctional activity at dopamine receptors in patients with schizophrenia. Better understanding of the mechanism of antipsychotic action at dopamine receptors may further reveal how dopamine modulates reward processing. Antipsychotic medications may have differential effects on components of reward processing, such as response to feedback, anticipation of reward, and reward receipt. To explore this, we tested patients with schizophrenia (n=20) taking a variety of atypical antipsychotics and matched healthy controls. Participants underwent functional magnetic resonance imaging (fMRI) while performing a reward-learning task. On each trial, participants first chose a shape, next received probabilistic feedback (correct, incorrect), and then received a monetary outcome. This task took place in two counterbalanced conditions, where the first involved accumulating monetary gain (Gain condition) and the second involved avoiding monetary loss (Loss condition). Using model-based analyses, we found that medication-dose in patients modulated fMRI response in the midbrain at the time of feedback, but only in the Loss condition. This finding suggests that pharmacological blockade of dopamine may influence valence-specific feedback-related mechanisms in patients with schizophrenia. Detailed models are currently being used to examine the impact of medication-strength and type during response to feedback, anticipation of reward, and receipt of reward in Gain and Loss conditions.

C105

GENDER DIFFERENCES IN FINANCIAL RISK-TAKING Deena Girgis[1], Vlad B Papa[2], Cary R Savage[2], Keith W Chauvin[1], Laura E Martin[2]; [1]University of Kansas, [2]University of Kansas Medical Center — Previous neuroimaging studies have shown that risk-seeking decisions activate reward processing brain regions such as the nucleus accumbens whereas risk-averse studies activate emotional brain regions such as the anterior insula. Little research has been done to specifically examine differences between men and women in these reward processing brain regions. The current study examined gender differences in risk-taking behaviors using questionnaires and a financial decision-making functional magnetic resonance imaging (fMRI) task. This task involved choosing between a stock and a bond. The probability of payout was given for both options. Trials distinguished risk-averse and risk-seeking decisions by varying the expected values of the stock and bond. Preliminary behavioral results show that while men make more recreationally-risky decisions by having strong responses to sample question such as likeliness to "take a weekend skydiving class" ($p=.07$), women make more socially-risky decisions by exhibiting strong responses to items such as likeliness to "reveal a friend's secret to someone else" ($p<.05$). In addition, men engage in more approach behaviors ($p<.05$). In the financial risk-taking task, men made more risky decisions compared to women (chose the stock when the bond had a higher expected value; $p<.05$). These preliminary results suggest that there are gender differences in risk-taking behaviors. In addition to behavioral data, fMRI results will be presented describing gender differences in brain activation associated with making risky decisions.

C106

MACHINE LEARNING OF SOCIAL DECISION-MAKING: AN FMRI STUDY OF THE ULTIMATUM GAME Filippo Rossi[1], Luke Chang[1], Ian Fasel[1], Alan Sanfey[2]; [1]University of Arizona, [2]Donders Institute for Brain, Cognition and Behavior, Radboud University — Social decision-making is a complex process with multiple sources of (conflicting) motivations at play, such as monetary interest and emotions. Suppose for instance that you are bargaining with someone and you receive a monetary offer that you consider insufficient: you may refuse it, even if it means loosing money. The Ultimatum Game (UG) is an economic game that mimics this scenario. Experimental evidence shows that players are guided by multiple motivations, and that they experience visceral reactions, such as disgust and anger, when playing the game. To better understand the role of these motivations, we used machine learning techniques to analyze BOLD signals from UG-players. First, we used statistical feature selection to extract a subset of 45 informative voxels. We then trained Support Vector Machines to recognize the pattern of activations that predict participants' decisions. Both feature selection and classification were conducted using leave-one-subject-out cross validation. Classification performance was significantly better than chance and flat prediction (accuracy = 63%, $p = .037$). The feature selection procedure extracted small clusters of voxels in the right insula, caudate, lateral prefrontal cortex, orbitofrontal cortex, and temporal pole. A few voxels were also extracted from visual and motor areas. Most likely, complex cognitive processes such as social decision-making depend on the synergic activity of multiple brain regions. Our results contribute to the investigation of the social decision-making network by identifying multi-voxel patterns of activation that are associated with specific social outcomes.

C107

PROCESSING OF MONETARY FEEDBACK IN ACTIVE AND OBSERVATIONAL LEARNING IN ASPERGER SYNDROME: RELATIONSHIP WITH EMPATHY? Christian Bellebaum[1], Katja Brodmann[1], Patrizia Thoma[1]; [1]Ruhr University Bochum, Germany — Deficits in reward processing and in emotional and cognitive aspects of empathy have been hypothesized to underlie the problems in social interaction observed in autism spectrum disorders (ASD). Both types of impairments may play an important role in learning from observed behaviour and feedback in other persons. In the present study, reward processing in active and observational learning from feedback was compared in ten adults with Asperger Syndrome (AAS) and twelve age matched healthy control subjects (HC). Associations between stimuli and monetary outcomes were either learned via active choices or by observing choices and outcomes of a virtual other person. Outcome processing was assessed with event-related potentials, focusing on the feedback-related negativity (FRN). For the behavioural data, an overall trend towards better learning performance in HC emerged, which was mainly driven by group differences in observational learning. Analysis of the FRN corroborated previous findings with respect to enhanced amplitudes for negative than positive feedback and for active vs. observational learning. In addition, FRN amplitude was generally reduced in AAS, irrespective of learning (active or observational) and feedback type (monetary reward or punishment). This finding adds to recent evidence of reduced reward system recruitment during reward processing in ASD and additionally shows that the reduction is comparable for feedback given for one's own behaviour and for feedback given to an observed person. However, FRN amplitude correlated with empathic concern only in AAS in observational learning, suggesting that the mechanisms responsible for FRN amplitude reduction may differ for active and observational learning.

C108

DAT1, DRD4, MAOA, STIN2, AND 5HTTLPR DO NOT ALTER ECONOMIC PREFERENCES FOR RISK, LOSS AVERSION, OR STRATEGIC USE O'Dhaniel Mullette-gillman[1,2], Edward McLaurin[1], Kelly Schiabor[1], Athy Robinson[1], Elizabeth Cirulli[1], David Goldstein[1], Michael Platt[1], Pate Skene[1], Scott Huettel[1]; [1]Duke University, [2]National University of Singapore — Using a test-replication split-sample design we examined how genetic variability in the dopaminergic and serotonergic systems may account for individual variability in economic preferences (total sample N~1400). Our independent phenotypes – risk preference, loss aversion, and strategic use – were derived from incentive-compatible economic tasks. Our genetic polymorphisms were five variable number of tandem repeats (VNTRs) from the dopaminergic and serotonergic systems: DAT1 (40bp VNTR), DRD4 (48bp VNTR), MAOA (uVNTR), and 5HTTLPR (long/short) and Stin2 on the SLC6A4 gene. Each VNTR has previously been reported to modulate economic preferences with effect sizes of up to 20%. However, prior studies have typically used fewer than 300 participants, which represent very small sample sizes for behavioral genetics work. Our first sample (N ~700) found no relationships between risk preferences and these polymorphisms, contrary to prior reports. Rather, we found evidence suggesting that DAT1 accounted for ~2% of loss aversion. In the second, replication sample (N ~700 new participants) we found no relationships between loss aversion and DAT1, nor between any of the phenotypes and the five VNTRs (all $p>0.05$, and effect sizes less than 0.3%). Thus, we conclude that these genes individually make very small contributions to economic preferences, consistent with the idea that such preferences reflect the collective activity of a large number of genes. Our results indicate that examination of gene-decision relationships in small samples, in contrast, could lead to overestimation of potential effect sizes.

C109

LOADED REELS: NEAR-MISS OUTCOMES DURING GAMBLING DISTORT FRONTAL-CORTICAL REWARD PROCESSING MECHANISM Scott Oberg[1], Matthew Tata[1]; [1]University of Lethbridge — Electronic gambling games (EGMs) are extremely popular and account for billions of dollars in gambling revenue. When players receive feedback concerning the outcome of their bets, that feedback is often more complex than a simple win/lose. Such games commonly feature an artificially high occurrence of "near-misses". In such reward processing tasks, the frontal cortex integrates outcomes of behavioural choices over time. We tested how the occurrence of near-misses distorts this integration process. In our paradigm, derived from the Iowa Gambling Task (IGT), the player repeatedly chose between bets with a negative long-run expected value (disadvantageous), or a positive long-run expected value (advantageous). As in the IGT, players who learned the task biased their bet choices toward the advantageous bet over time. Feedback on the task consisted of three coloured "reels" combined that displayed one of three options: a win (all reels the same colour), a near-miss (first two reels the same colour), or a full miss (all reels different). Increasing near miss rates above chance caused players to choose the disadvantageous bet more often than when near misses occurred at chance levels. These findings suggest that near misses distort a player's ability to accurately identify the risk associated with the game. To further investigate this distortion, we recorded the Event-Related Potential associated with wins, losses and near-misses. The feedback-related negativity associated with near-misses was distorted relative to full losses suggesting that frontal-cortex mechanisms of reward processing are disrupted by the elevated near-miss outcomes that are common in EGMs.

C110

TEMPORAL CHARACTERISTICS OF DECISION-MAKING IN A DELAY-DISCOUNTING TASK: AN EEG TIME-FREQUENCY PERSPECTIVE. Uku Vainik[1,2], Andero Uusberg[1], Jüri Allik[1]; [1]University of Tartu, Estonia, [2]Montreal Neurological Institute — Delay discounting (DD) portrays impulsive decision-making. Here, we used EEG to study changes in brain activity over time before the actual decision in a DD task. Forty-six university students chose between smaller-immediate and larger-later rewards (reward size: 1-61 vs 62 euros, delays: 0 vs 2,4,10 weeks, avg. response time: 3s) and EEG was simultaneously acquired from 32 electrodes. The analysis of event-related potentials replicated previously reported differences in P2, N2 and P3 amplitudes. A time-frequency analysis of the first 1000 ms post stimulus revealed that theta frequency (4-8 Hz) and alpha frequency (8-13 Hz) levels systematically varied across conditions. In particular, higher theta levels during the first 250 ms post stimulus predicted the choice of an immediate reward. Alpha levels increased between 250-1000 ms post stimulus as the delays to larger-later rewards increased, but only when the immediate reward was ultimately chosen. These results suggest that: a) very fast theta-related processes might ultimately determine the preference for a smaller-sooner reward; b) alpha is related to information processing about the delayed reward. Cortical theta and cortical alpha signals have been hypothesized to reflect limbic and cortical activity respectively. The present findings thus mirror known limbic-cortical activation patterns seen in fMRI studies of DD, with higher limbic activity predicting the choice of an immediate reward, and cortical activity varying according to delay information. Our results provide insight into the time course of these processes, suggesting that the limbic activity occurs before delay-related cortical activity. Therefore, fast limbic signals might determine impulsive decisions.

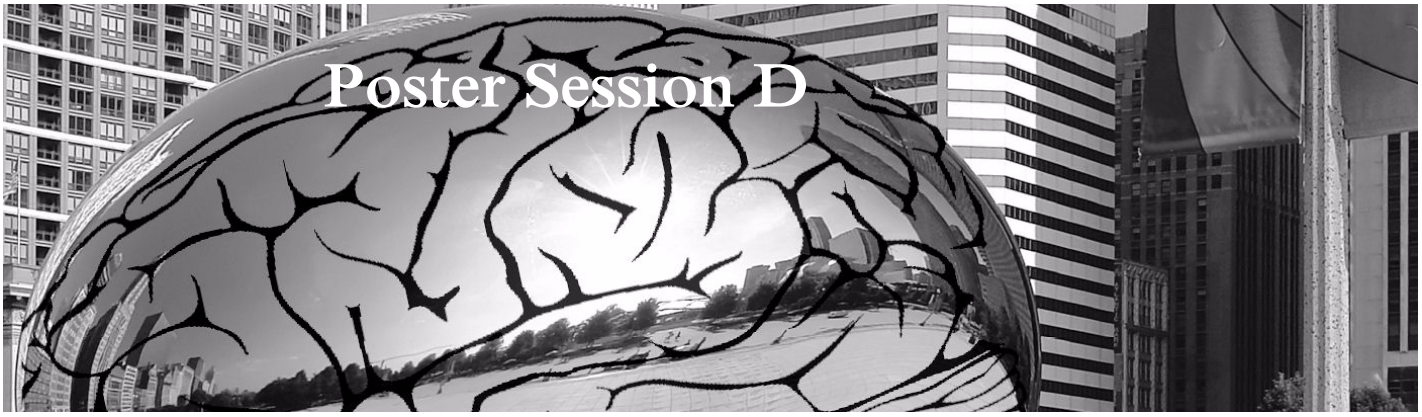
C111

MODULATION OF VENTRAL STRIATAL ACTIVITY BY SUBJECTIVE COGNITIVE EFFORT. Ekaterina Dobryakova[1], Elizabeth Tricomi[1]; [1]Rutgers University, The State University of New Jersey — Goal-directed behavior is driven by reward desirability and by amount of effort required to obtain the goal. Previous neuroimaging work points to a role of the ventral striatum (VS) in coding for reward value, but it is unclear how cognitive effort required to achieve a goal may influence subjective reward value and activity in the VS. Effort-discounting theory states that humans prefer low effort actions that result in high reward; this theory predicts decreased VS activity for rewards acquired with more effort. However, contrast theory states that an outcome of a more effortful action would be preferred due to a greater contrast between the aversive action and the rewarding nature of the outcome; this theory predicts increased VS activity for rewards acquired with more effort. To test these alternative hypotheses, we used functional magnetic resonance imaging (fMRI) as participants engaged in feedback-based learning that required low (LE) and high cognitive effort (HE) to obtain positive feedback while the objective amount of information provided by feedback remained constant. No significant difference in accuracy was observed between the effort conditions but all participants indicated that the HE condition was more difficult. Increased VS activation was associated with feedback presented during the HE condition relative to the LE condition, when controlling for activation from corresponding control conditions for which feedback was random, rather than based on performance. These results suggest that increased cognitive effort produces corresponding increases in VS activity, in line with the predictions made by contrast theory.

C112

PSYCHOPHYSIOLOGICAL CORRELATES OF IMPAIRED DECISION MAKING AMONG OLDER ADULTS Georgina Moreno[1], Bryan Koestner[1], Kenneth Manzel[1], David Warren[1], Kristin Decorrevont[1], Natalie Denburg[1]; [1]University of Iowa — Previous work in our laboratory has found evidence to support the hypothesis that some seemingly healthy older adults have deficits in real-world judgement and decision making abilities. Denburg et al. (2007) demonstrated that a subset of older adults (approximately 35-40%) perform disadvantageously on the Iowa Gambling Task (IGT), an ecologically valid laboratory task of decision making task. This study found that IGT performance predicted susceptibility to the influence of deceptive advertising. That is, impaired decision makers were more vulnerable to deceptive advertising than unimpaired decision makers. In the current study, we sought to further investigate the psychophysiological correlates of defective decision making among healthy older adults

through the use of an eye tracking apparatus. Eye movements were recorded as participants were exposed to advertisements on a computer screen with deceptive and non-deceptive claims drawn from cases deemed problematic by the Federal Trade Commission. After viewing of advertisements, a questionnaire was administered examining participants' comprehension of claims and purchase intentions and subjects were classified as either being deceived or not deceived. We found IGT performance to be positively correlated with comprehension of claims. Additionally, unimpaired decision makers were less likely to be deceived than impaired decision makers. Furthermore, older adults that evidenced being deceived spent more time in key regions of interest and demonstrated more fixations in key regions of interest while viewing deceptive advertisements. This research begins to identify a neuroscientific explanation as to why some older adults have a heightened vulnerability to falling prey to advertisement fraud.



Sunday, April 1, 4:00 - 6:00 pm, Exhibit Hall

ATTENTION: Nonspatial

D1

ELECTRICAL NETWORK CORRELATES AND PREDICTORS OF RESPONSIVENESS TO REPETITIVE THETA BURST MAGNETIC STIMULATION (RTBS) Sviatlana Dubovik[1], Radek Ptak[1], Armin Schnider[1], Adrian Guggisberg[1]; [1]Division of Neurorehabilitation University Hospital of Geneva, Switzerland — Despite the emerging number of therapeutic rTBS applications, the percent of responders remains moderate [1]. rTBS is able to induce transitory neglect-like visual exploration behavior in healthy participants when applied to the right posterior parietal cortex (PPC) [2]. This ongoing study aims to understand the electrophysiological network differences associated with responsiveness to rTBS. Six young healthy subjects underwent three sessions of inhibitory (30 Hz bursts at 10Hz) rTBS of the right PPC, the frontal eye field (FEF), or sham stimulation. Before and after stimulation, visual exploration of images was recorded with an eye tracking device, and resting-state EEG recordings were obtained. The neural oscillations at each grey matter voxel were reconstructed using an adaptive spatial filter. The functional connectivity (FC) of each voxel with the rest of the brain was calculated and correlated with left-sided visual exploration. Alpha-band FC in the right PPC was linearly correlated with left-sided visual exploration. rTBS induced an increase of FC in the stimulated area at 10 Hz and in the left PPC at 20, and 30 Hz, which correlated with the induced neglect effect. Greater FC in the right PPC before stimulation was a reliable predictor for the expected rTBS effect. Behavioral effects of rTBS are associated with changes in electrical network interactions and can be predicted by FC states before stimulation. Thus, FC analyses based on EEG might help optimize therapeutic rTBS in individual patients.

D2

PAYING ATTENTION TO TIME Janice Snyder[1], Anjan Chatterjee[2]; [1]University of British Columbia, [2]University of Pennsylvania — Deploying attention to time optimizes behaviour by allowing us to anticipate events. Directing attention to a temporal interval when an impending target will occur confers a processing advantage as measured by decreases in reaction time (RT) and increases in accuracy. At present, we do not know if the right hemisphere (RH) or the left hemisphere (LH) is biased to take advantage of sub-second temporal cues in predicting the onset of future events. The contribution of each hemisphere to temporal attention was examined in two tasks in patients with diverse RH (n=10) and LH (n=13) lesions and compared to the performance of age-matched controls. The first task measured the ability to discriminate between short and long cue durations (300 and 900 ms, respectively). The second task provided a measure of temporal attention using a modified Posner-type cuing task with cue duration (300 or 900 ms) accurately predicting (i.e., 80% valid) target onset time and assessing cue benefits (i.e., facilitation effects: invalid long RT – valid short RT). Cue discrimination was equivalent for RH and LH lesions (81 and 72%, respectively) but reduced relative to the age-matched controls (97%). Facilitation effects were equivalent for LH lesions and age-matched control (51 and 48 ms, respectively) but compromised for RH lesions (7 ms). Interestingly, despite equivalent cue discrimination for RH and LH lesions, for RH lesions, cue discrimination was positively correlated with facilitation. These results suggest that RH damage affects people's ability to discriminate sub-second durations and to use this information to anticipate events.

D3

CATEGORY-BASED ATTENTION CHANGES THE NEURAL REPRESENTATION OF NATURAL SCENE CATEGORY Audrey Lustig[1,2], Eamon Caddigan[1,2], Li Fei-Fei[3], Diane Beck[1,2]; [1]University of Illinois, [2]Beckman Institute, [3]Stanford University — Visual discrimination can be improved by attending to spatial locations, simple features, and objects. Can humans also use a more complex template to improve discrimination between categories of natural scenes? Previous work suggests that natural scene discrimination is unimpeded by dual task conditions (Li et al., 2002); however, more recent work shows that scene recognition is impaired under dual-task conditions if the subjects are not expecting a scene (Cohen et al. , 2011). These results suggest that scene recognition benefits from top-down expectation. In the current study, we used MVPA to investigate whether searching for a scene category changes the neural representation of that scene category. Subjects viewed blocks of images from four scene categories (beaches, cities, highways and mountains) and counted the number of images from a target category for each run. Although mean activation in PPA was similar when a category was a target versus non-target, decoding accuracy differed as a function of whether the category was a target or non-target. Specifically, decoding accuracy for beaches improved when beaches were the target category, whereas decoding accuracy for mountains was lower when mountains were the target category. Surprisingly, searching for mountains increased the likelihood that a mountain was classified as a beach, and searching for highways increased the likelihood that a highway was classified as a city. These results suggest that, for some scene categories, expectation improves the representation of that category, whereas for other scene categories, expectation may cause the representation to become too restrictive.

D4

POST-PERCEPTUAL PROCESSING OF TASK-IRRELEVANT INFORMATION IS RELATED TO PERFORMANCE DURING THE ATTENTIONAL BLINK. James Elliott[1], Barry Giesbrecht[1]; [1]University of California, Santa Barbara — Our ability to attend to relevant information is both spatially and temporally limited. One example of the temporal limitation is the attentional blink (AB), which is a decrease in identification accuracy of the second of two targets (T1 and T2) presented 200-500 ms apart. Interestingly, previous studies have found that presenting task irrelevant visual and auditory information concurrently with T2 during the AB attenuates the performance impairment. Here we examined the neural correlates of this attenuation of the AB by measuring the neural response to a task-irrelevant probe (white circle) presented above T2 on half the trials. Behavioral performance was higher on probe-present trials, particularly during the AB. Additionally, there was a main effect of T2-lag on the peak latency of the probe-elicited P3 ERP, such that the latency during

the AB (m=485 ms, SEM = 11.03 ms) was later than outside the AB (m = 434 ms, SEM = 9.4 ms; p <.05). The mean amplitude of the probe-evoked P3 was positively correlated with the increase in behavioral performance during the AB (r = .33, p < .05). The behavioral results suggest that the increase in performance caused by the concurrently presented probe was more robust when attention is susceptible to failure. Furthermore, the ERP results suggest that the performance improvement may be a result of the post-perceptual processing of the probe, which could act as a cue and thereby facilitate the processing of T2.

D5

EFFECTS OF LATERALIZATION ON THE ATTENTIONAL BLINK FOR EMOTIONAL AND NON-EMOTIONAL STIMULI. Marcia Grabowecky[1], Laura Ortega[1], Chika Nwosu[1], Satoru Suzuki[1]; [1]Northwestern University — Emotional events can attract and capture attention, and emotional faces are particularly salient emotional stimuli. Faces, emotional or not, may also be preferentially processed in the right hemisphere. We used a lateralized attentional blink paradigm to investigate whether presentation of emotional faces to the left or right hemisphere differed in attentional blink magnitude. Three different male faces expressing neutral, happy or angry expressions were targets. One upright face target was neutral and the second emotional, or both were neutral, while distractors were selected from a different set of neutral inverted faces. A second group performed a lateralized version of a standard attention blink task with upright letters as targets and inverted letters as distractors. We hypothesized that letters, as linguistic stimuli, might be preferentially processed in the left hemisphere. Stimuli for both tasks were presented centered at 3.72° from the fixation point on the left or the right. Participants were pre-cued about the stimulus location, and we verified fixation throughout each trial with an eye-tracker, terminating any trial where the eyes deviated vertically or horizontally more than ±2.14° from the fixation point. We found that the magnitude of the attentional blink was reduced for left-visual-field/right hemisphere presentations (LVF/RH) for both face and letter stimuli, suggesting that the reduction in blink magnitude for LVF/RH was not due to specialization for faces. It is possible that the right hemisphere is better at processing rapid stimuli, or is better at discriminating upright and inverted stimuli than is the left hemisphere.

EMOTION & SOCIAL: Emotion-cognition interactions

D6

GENDER DIFFERENCES IN THE NEURAL SUBSTRATES OF EMOTIONAL CONFLICT DURING ADOLESCENCE Anita Cservenka[1], Madison L. Stroup[1], Khadiya J. Chinnarath[1], Bonnie J. Nagel[1]; [1]Oregon Health & Science University — Adolescence is a developmental period characterized by heightened emotional reactivity and immature top-down executive control, which may underlie vulnerabilities associated with the emergence of psychiatric disorders during this time. In particular, gender differences in brain functioning may contribute to gender-specific vulnerabilities to psychopathology seen during adolescence. Thus, the goal of the current study was to investigate adolescent gender differences in brain functioning during functional magnetic resonance imaging of an emotional processing task requiring inhibitory control (Etkin at al., 2006). During the task, participants were required to indicate the emotion of facial expressions while disregarding emotion-congruent and incongruent words printed across the faces. In order to examine gender differences in emotional inhibition, 28 age-matched participants were divided into adolescent girls (n=16) and boys (n=12) (mean age=13.37±.31). No gender differences in task performance were present. Using an analysis of covariance, covarying for pubertal status, we found that girls had greater brain activity in the posterior cingulate cortex (PCC)/precuneus during correct congruent vs. incongruent trials compared to boys (p<0.05, voxel/clusterwise corrected). On average, girls showed significantly weaker activity in the PCC/precuneus during incongruent trials, a distinction not seen in boys. The precuneus/PCC is a major hub for cortical networks, including the cingulo-opercular network, which is important for attentional control. Under-recruitment of this region during incongruent trials in girls may suggest weaker attentional control over emotionally salient stimuli in the presence of task-irrelevant stimuli. Thus, disruptions in emotional inhibition and regulation could confer vulnerability for the emergence of psychiatric symptoms in adolescent girls.

D7

RE-ENVISIONING EMOTIONAL REAPPRAISAL: A NOVEL TASK FOR EXPLORING COGNITIVE CONTROL OF EMOTION Larissa Borofsky[1], Darby Saxbe[1], Jonas Kaplan[1], Xiao-Fei Yang[1], Gayla Margolin[1]; [1]University of Southern California — The present study uses a novel approach to explore the behavioral and neural correlates of emotional reappraisal in adolescence. Emotional reappraisal is a cognitive strategy for regulating emotions where an initial emotional reaction is consciously reevaluated and changed. Difficulties with reappraisal are associated with interpersonal problems and decreased well-being. Previous studies of emotional reappraisal have used an extensive training method for eliciting reappraisals. Although this approach has been found effective with adults, it is time consuming and may be problematic with adolescents who have less cognitive maturity. This study uses a novel "prompted reappraisal" task in which participants observe emotional images and then view captions that either maintain or change the emotional interpretation of a scene. This task requires only brief training (to familiarize the subject with the task) and reduces the cognitive demands on the subject. This task may also help dissociate two important components of reappraisal, because it targets the ability to disengage from an emotion, but does not require the participant to generate a novel appraisal. The pilot sample included 14 youth (6 female), ages 15 to 18. Behavioral results indicate that the task successfully manipulated participants' emotional reactions to the stimuli. In addition, brain regions showing relative signal increases during the reappraisal conditions included the medial prefrontal cortex and regions showing decreased signal included the insula, consistent with prior evidence from standard reappraisal tasks. Taken together, these results indicate that this novel task may contribute an important new approach to research on reappraisal.

D8

PERSUASION IS CHARACTERIZED BY SIMULTANEOUS LIMBIC AND PREFRONTAL ACTIVATION Ian Ramsay[1], Marco Yzer[2], Monica Luciana[1], Kathleen Vohs[3], Angus MacDonald[1]; [1]Department of Psychology, University of Minnesota, [2]School of Journalism and Mass Communication, University of Minnesota, [3]Carlson School of Management, University of Minnesota — Theories of health message communication posit that both affective and executive processes are important for successful behavior change. However, it remains unclear how the brain networks responsible for these processes cooperate while viewing persuasive messages. In this study, 65 adolescents (ages 15 to 19) made real-time affective appraisals in response to 10 anti-drug public service announcements (PSAs) previously found to be strongly convincing, 10 found to be weakly convincing, and 10 non-drug related advertisements, during an fMRI scan. Results showed that while both strong and weak anti-drug PSAs elicited arousal-related brain activity in limbic (amygdala, nucleus accumbens, OFC) and medial prefrontal brain regions, strong compared to weak anti-drug PSAs elicited arousal-related activity in lateral prefrontal cortical regions associated with control (IFG, MFG). A functional connectivity analysis also showed greater functional co-activation between amygdala and the lateral prefrontal cortex during strong compared to weak anti-drug PSAs. These findings suggest that strongly persuasive messages elicit increased simultaneous activation in brain regions responsible for emotional arousal and executive control.

D9

EXECUTIVE CONTROL OF EMOTIONAL MEMORY: AFFECTIVE MNEMONIC SELECTION AND INHIBITION Crystal Reeck[1], Kevin S. LaBar[1]; [1]Duke University — The flexible nature of memory enables it to conform to an organism's goals in order to promote adaptive behavior. During retrieval, executive control of memory is vital to ensuring appropriate, goal-relevant memories are selected and that inappropriate, competing memories are inhibited. This suppression results in enduring impairment of the inhibited mnemonic representation, and the selection processes result in lasting enhancement of practiced memories. Although many aspects of the processes by which this selection and inhibition occur have been illuminated, it remains unclear whether these same processes are modulated by the affective content of the memories being targeted. To investigate the effects of executive control processes on affective mnemonic representations, a retrieval-induced forgetting paradigm was adapted to include both affectively negative and neutral words. Participants encoded neutral cue words and affectively negative or neutral associates. Following initial encoding, participants selectively retrieved a subset of these associates multiple times. During this retrieval practice phase numerous executive processes mobilize to enable the selection of the specific memory cued and inhibit the retrieval of competing memories. The consequences of these executive processes were examined on a final memory test in which recall for all studied associates was probed. Behavioral analyses indicated that both affectively neutral and negative mnemonic representations experienced similar levels of enhancement and impairment following selective retrieval, demonstrating the susceptibility of affectively salient memories to executive control processes. Prefrontal control regions likely support these mnemonic control processes, although affect may modulate the neural mechanisms supporting executive control in memory.

D10

WHEN MY ERRORS ARE YOUR PAIN: EFFECTS OF AGENCY ON PAIN EMPATHY Leonie Koban[1,2], Corrado Corradi-Dell'Acqua[1,2], Patrik Vuilleumier[1,2]; [1]Neuroscience Center, University of Geneva, [2]Swiss Center for Affective Sciences — A growing body of evidence suggests that humans' ability to empathize with others' pain is instantiated in those neural structures, such as the anterior cingulate (ACC) and insular (AI) cortex, which are involved in the direct experience of pain. On the other hand individuals might, deliberately or not, cause pain to others, but the question of how this causal agency influences the neural underpinnings of pain empathy has not been addressed yet. In an event-related fMRI experiment, participants played a visual judgment task in turns with a friend placed outside the scanner. Errors always led to monetary losses to both players but, in half of the erroneous trials, an additional painful stimulation was applied to the friend. This allowed to investigate the neural underpinnings of self- vs. other-generated errors (factor: AGENCY) which, in turn, might yield to vicarious experience of a painful vs. painless heat (factor: PAIN). Behaviorally, self-caused painful errors were associated with increased guilt and higher pain ratings than other-caused painful errors. Functional imaging results showed, consistently with previous studies, a main effect for PAIN, with enhanced activity in ACC and AI for painful (rather than painless) errors. Critically, these regions were also associated with a significant PAIN*AGENCY interaction, reflecting increased pain-related activations when errors were caused by oneself. We provide unprecedented evidence of top-down influences of agency on empathy which might be well suited to study abnormal empathic or moral emotions in clinical populations such as psychopathy and depression.

D11

GENERATING BROAD SEMANTIC ASSOCIATIONS INCREASES POSITIVE MOOD AND ACTIVATES THE RIGHT PREFRONTAL CORTEX Tad Brunye[1,2], Stephanie Gagnon[1,2], Caroline Mahoney[1,2], Holly Taylor[1]; [1]Tufts University, [2]U.S. Army NSRDEC — Recent theory proposes a reciprocal relationship between cortical networks linking mood and associative processes [Bar, M. (2009). Trends in Cognitive Sciences, 13, 456-463.]. Though several studies demonstrate that positive mood can increase the breadth of associative processing, we tested the reciprocal prediction: that associative processing should increase positive mood. Three experiments tested this prediction. Study 1 measured mood change as a function of associative strength between cues and generated free associates; the generation of relatively broad associates, but not the valence of the produced associate, predicted more positive moods. Study 2 measured mood change as a function of generating associates within narrow versus broad word contexts; results indicated more positive moods in response to the relatively broad contexts. Finally, Study 3 used functional near-infrared spectroscopy (fNIRS) to monitor prefrontal cortical activation during an association task designed to elicit word associations in response to broad versus narrow contexts. Results indicated right versus left hemisphere prefrontal activation in response to generating words in broad versus narrow contexts, respectively. Overall, our findings carry implications for the reciprocal relationship between the prefrontal cortex and medial temporal lobe, and may hold promise for enhancing positive mood in depression and other clinical and applied contexts.

D12

YOUTH WITH DISRUPTIVE BEHAVIOR DISORDERS AND CALLOUS-UNEMOTIONAL TRAITS SHOW IMPAIRED NEURAL REPRESENTATION OF EXPECTED VALUE Stuart White[1], Katherine Fowler[2], Stephen Sinclair[1], Daniel Pine[1], James Blair[1]; [1]National Institute of Mental Health/NIH, [2]Centers for Disease Control — Background: In previous work, we have shown that youth with Disruptive Behavior Disorders (DBD: Conduct Disorder and Oppositional Defiant Disorder) and callous-unemotional (CU: reduced guilt and empathy) traits show impaired decision-making that is coupled with dysfunctional responding within the amygdala and orbitofrontal cortex (OFC; Finger et al., 2008). However, this work has not distinguished between dysfunction during decision-making vs. feedback, nor has it examined decision-making with respect to environmental reinforcements (e.g., appetitive stimuli, physical threats, or contamination threats). Methods: Using a novel affective decision-making paradigm, fMRIs were conducted on15 youth with DBD+CU and 15 matched controls. Results: Regions showing a diagnosis by choice by emotion interaction included right orbital frontal cortex, right middle frontal gyrus, two areas in the right insula, left cingulate cortex, left caudate and thalamus. When making poor decisions (choosing to open disgust/threat doors, choosing not to open positive doors), healthy controls showed increased activation relative to DBD+CU youth. Contrary to predictions, dysfunction during feedback was not observed. Conclusions: Youth with DBD+CU traits do not appear to be generating the same warning signaling that the healthy youth do when choosing to make poor decisions. These data support previous suggestions that the neural representation of expected value is disrupted in youth with DBD+CU. Disclosures: None.

D13

THE FRACTAL DIVIDE - WHEN COMPLEXITY MATTERS: AFFECTIVE & COGNITIVE RESPONSES TO MUSIC Sherri Novis[1], Patrick CM Wong[1]; [1]Northwestern University — Based on cross-disciplinary work, we designed a series of experiments to test the hypothesis that the effects of optimal musical complexity can be measured across higher order systems, such as perception, emotion, and cognition. Specifically, we predicted that when the perception of melodicity peaks (optimal complexity), emotion and memory will peak as well. In addition, we predicted the optimal complexity effect would remain stable, while the effects of non-optimal complexity would be sensitive to repeated listening. In two experiments, we used fractal (1/f^B) tone sequences to compare the effects of objective complexity (fractal value B) on user ratings of perception (subjective complexity and melodicity), emotion (preference and mood) and cognition (memory), while also controlling for the effects of timbre (piano and violin) and item-specific pitch patterns (seqA and seqB). We then repeated the procedure five times within a 10-day period (session 1-5). Results demonstrated all measures peaked when fractal values were

moderately complex, and those peaks remained stable throughout repeated exposure. Most notably, mood and memory reached unsurpassed peaks after a single exposure and all significant sensitivities to repeated exposure occurred outside of the optimal fractal value range. Findings support the hypothesis that the CNS demonstrates a domain general sensitivity to a particular range of acoustic complexity, and that sensitivity contributes to the perception of music and concurrent emotional and cognitive responses. Results are discussed in terms of the universal appeal of music, and a potential evolutionary adaptation for acquisition of important sound structures.

D14

THE INFLUENCE OF PSYCHOPATHIC TRAITS ON THE ULTIMATUM TASK
Sarah Brislin[1], Stuart White[1], Kayla Pope[1], Stephen Sinclair[1], R.J.R. Blair[1]; [1]Unit on Affective Cognitive Neuroscience, National Institue of Mental Health, NIH — Background: Previous research has shown increased anterior insula responses to unfair offers during social interactions (Sanfey et al., 2003) and increased striatal activation when punishing unfair actors (Quervian et al., 2004). The current study examined the impact of psychopathic traits on these responses. Methods: Healthy adults completed a Ultimatum task during fMRI scanning. In this task, the participant played with a computer "partner." The partner offered splits of a common pot of money with the participant. The offers were either an even split or varying degrees of unfair offer. Participants could accept the offer or choose to punish the other player at a cost to themselves which increased with the amount of punishment. Results: Increasingly unfair offers were associated with significantly increased responses within bilateral anterior insula, dorsomedial prefrontal cortex and bilateral dorsolateral prefrontal cortex. Increased allocations of punishment to the other were associated with increased activity within the caudate but decreased activity within ventromedial prefrontal cortex. Conclusions: Consistent with previous work, increasingly unfair offers were associated with increasing bilateral insula activation and increasing punishment of unfair offers was associated with increasing caudate activity. The modulation of the presence of increasing psychopathic traits on these responses will be discussed. References: Sanfey. A.G., Rillinget al (2003). Science, 300, 1755-1758. De Quervian, D.J.F., et al (2004). Science, 305, 1254-1258.

D15

EARLY VISUAL PERCEPTION IS SHAPED BY ATTENTION CONTROL AND AFFECTIVE STATE: EVIDENCE FROM PSYCHOPHYSICS AND ERPS
Valentina Rossi[1], Gilles Pourtois[1]; [1]Ghent University — Recent neurophysiological findings suggest that not only selective attention, but also affective state may gate early sensory processing in human V1. In a series of behavioral and ERP studies we tested (i) whether early gain control effects may be associated with a perceptual change in the spatial encoding of the stimulus; (ii) whether attention vs. emotion control mechanisms lead to comparable changes in perception. Healthy participants were tested using a dual task, enabling a parametric modulation of perceptual load for the primary task at fixation, while accuracy for the spatial encoding of visual stimuli shown at different locations in the upper visual field (UVF) was measured (secondary task). Results show a decrease of accuracy (i.e. regression toward the perceived mean location in the UVF) when either load at fixation increases (Experiment 1) or state anxiety was transiently enhanced (Experiment 2). Control analyses confirmed that these effects were not explained by differential eye movements towards the UVF. Hence, attention and affect lead to similar changes in visuo-spatial perceptual abilities. Additional ERP results focusing on the striate C1 component (generated in V1) corroborate the assumption that attention and affective state both contribute to an early gating of sensory processing. Altogether, these findings suggest that load and affect-dependent modulations of the C1 may reflect a change in the spatial encoding of the stimulus during early sensory processing in V1. These results are discussed against the notion of concurrent attentional and emotional control mechanisms exerting modulatory effects in V1 early on following stimulus onset.

EMOTION & SOCIAL: Other

D16

PASS ME THE BALL! AN FMRI STUDY ON THE NEURAL BASIS OF ACTION UNDERSTANDING
Federica Riva[1,2], Brent Vander Wyk[1], Kevin Pelphrey[1]; [1]Yale University, [2]University of Milano-Bicocca, Italy — Unlike many previous studies of action perception, the aim of this study was to investigate action processing employing a more naturalistic, interactive paradigm. The fMRI experiment consisted of a balltossing game in which participants viewed video-clips of two players, one of which either asked for a ball (bid) or performed a simple up-and-down arm motion (control), either toward the participant (toward) or toward each other (away). Participants pressed a button to throw the ball to a player of their choice whenever a toward-condition was presented. Comparison of the bid-toward with the motion-toward condition displayed activation in the right STS (Superior Temporal Sulcus), confirming previous findings on the role of this region in action comprehension (Vander Wyk, 2009). Conversely, no significant differences were discovered between the away-conditions, showing the importance of participating in the action. The interaction of the two main factors (direction and action type) resulted in activation of the right Precentral Gyrus (BA6), an area belonging to the putative MNS (Mirror Neuron System) (Keysers, 2010), also involved in action processing. Lastly, the default-mode network, a set of regions usually less active with high demand tasks (Mason,2007), was unexpectedly more de-activated in the motion-toward than in the bid-toward condition. We suggest simple motion perception requires greater mental load to respond since it does not imply a request. The greater activation in STS and Precentral Gyrus in response to the bid-toward condition provides evidence of the importance of employing naturalistic paradigms in the study of social processes like action understanding.

D17

NICOTINE DECREASED ACTIVATION IN THE BRAIN REGIONS INVOLVED IN EMOTIONAL PROCESSING IN NON-SMOKING ADULTS
Julie Dumas[1], Kelly Carstens[1], Alexandra Potter[1]; [1]University of Vermont — Nicotine has been implicated in mood regulation. Additionally, a primary motivator of tobacco use is the alleviation of negative affect. However, little is known about how nicotine regulates emotional processing in the brain. This study examined the effects of nicotine administration on the brain circuitry involved in emotional processing in normal, healthy, nonsmoking adults using functional MRI. Brain activation was examined during the viewing of neutral, positive, and negatively-valenced images while subjects made pleasantness ratings of each picture on two study days. One day subjects wore a 7 mg nicotine patch for 45 minutes and the other day participants wore a matching placebo patch. During the viewing of neutral emotional images, nicotine modulated a broad network of brain regions. Specifically, compared to placebo, nicotine increased activation in the precuneus, parahippocampal gyrus, and occipital lobe, but decreased activation in the anterior cingulate, precentral gyrus, and middle frontal gyrus. Nicotine's modulation of brain regions was different when subjects made pleasant and unpleasant ratings for the pictures. Specifically, nicotine decreased activation in the posterior cingulate and amygdala for pleasant and unpleasant pictures relative to neutrally-rated pictures. These data suggested that nicotinic stimulation caused a modification in the neural circuitry involved the viewing of visually complex pictures and in particular modulated in the posterior cingulate which has been shown to be involved in processing emotional information. These data suggest a model of emotional neurobiology that is sensitive to nicotinic stimulation.

D18

THINKING IN PATTERNS: USING MULTI-VOXEL PATTERN ANALYSES TO FIND NEURAL CORRELATES OF MORAL JUDGMENT IN NEUROTYPICAL AND ASD POPULATIONS
Jorie Koster-Hale[1], Rebecca Saxe[1], Liane Young[2]; [1]Massachusetts Institute of Technology, [2]Boston College — Actions are judged morally wrong if the actor intended to cause harm, but not if the

same outcome was caused accidentally. This difference between intentional and accidental harm depends on thinking about another person's thoughts, a cognitive function associated with a specific and selective group of brain regions (the 'Theory of Mind network'), and especially one region, the right temporo-parietal junction (RTPJ). Prior research has found that (i) interfering with activity in the RTPJ, via transcranial magnetic stimulation, can shift moral judgments away from reliance on beliefs (Young et al 2010), and (ii) high-functioning individuals with Autism Spectrum Disorder (ASD) rely significantly less on beliefs, for moral judgments, than matched neurotypical (NT) control participants (Moran et al 2011). Puzzlingly, however, the average response in Theory of Mind regions is not different for intentional versus accidental harmful actions, in NT or ASD participants. Using Multi-Voxel Pattern Analyses (MVPA), we find that RTPJ – and not other regions in the Theory of Mind network – shows sensitivity in the pattern, but not magnitude, of response to the difference between intentional and accidental Harms. Second, we find that individual differences in pattern classification predict individual differences in behavior: individuals with more discriminable neural patterns showed a larger difference in moral judgments of accidental versus intentional harms. Finally, we find that the difference between intentional and accidental harms is not encoded in the voxel-wise pattern in participants with ASD, mirroring their moral judgments.

D19

DISSOCIATIVE REDUCTION OF INTRINSIC PREFRONTAL-STRIATAL CONNECTIVITY IN APATHETIC AND DEPRESSIVE STATE

Shuhei Yamaguchi[1], Chizuko Hamada[1], Keiichi Onoda[1]; [1]Shimane University — Apathy is defined as reduced motivation to engage in activities, and often occurs in various neurological and psychiatric disorders. Depression is also observed commonly in those diseases, and shares some psychiatric features with apathy. However, it is not well understood what kind of neural mechanisms differentially underlie apathy and depression. We studied the difference in resting-state network connectivity measured by functional MRI between apathetic and depressive state in seventy-four healthy subjects. Apathetic and depressive states were assessed using the self-rating apathy scale and Zung's depression scale, respectively. Using the independent component analysis we identified brain networks involving the striatum at first. Patterns of resting-state brain connectivity between striatum and other brain regions were extracted as functions of apathy and depression. Namely, modulation of connectivity by apathy was analyzed using the depression score as a covariate, and the apathy score was used for the analysis of depression. We found differential reductions of neural connectivity of the striatum with several regions of the prefrontal cortex by apathy and depression. Apathy score was inversely correlated with the strength of striatal connectivity with anterior part of the cingulate cortex and lateral orbitofrontal cortex, whereas depression score showed negative correlation with the connectivity with the middle prefrontal gyrus and dorsal part of medial prefrontal cortex. These results indicate that apathy was related to decrease of neural connectivity in ventro-medial prefrontal and striate network. This network is distinct from the dorsal-lateral prefrontal and striate network, whose impairment is associated with depressive state.

D20

NEUROPHYSIOLOGICAL CORRELATES OF EMOTION REGULATION IN PRESCHOOLERS: AN EXAMINATION OF THE EFFECTS OF SOCIO-ECONOMIC STATUS

Kathleen Kelsey[1], Nicolas Chevalier[2], Sandra Wiebe[3], Kimberly Andrews Espy[1,4]; [1]University of Nebraska-Lincoln, [2]University of Colorado-Boulder, [3]University of Alberta, [4]University of Oregon — Children's ability to regulate their emotions in response to the environment is a key developmental process required for both scholastic and interpersonal success. Disparities in cognitive control, highly involved in emotion regulation, are common among low SES children but research addressing underlying neural deficits is sparse. The goal of the present study was to examine differences in neurophsyiological response to frustration using Event Related Potentials (ERPs) across high and low SES children. Thirty children (M=5.66 years; SD=0.26), 43% of whom qualified for free/reduced price lunch, completed a task designed to induce frustration through negative feedback on 50% of trials despite accurate performance (i.e. rigged). A spatial-temporal Principle Components Analysis revealed 13 spatial and 12 temporal factors accounting for 91% of the variance in ERPs to feedback. A negative going late slow wave at fronto-central leads differed as a function of SES, $F(1,28)=15.77$, $p=0005$. A significant neural differentiation between fair and rigged trials was present for high SES children $t(1,16)=4.11$, $p=.0008$ but not for low SES children $t(1,12)=1.54$, n.s. Although the negativity was observed only for rigged trials among high SES children, low SES children demonstrated the same negative deflection for both trial types. Findings from the present study suggest children from high and low SES backgrounds differ in their neural response to stress. Implications of neurophysiological differences will be discussed in terms of cognitive and neural efficiency.

D21

ALLELE SPECIFIC DNA METHYLATION OF OXYTOCIN RECEPTOR GENE PREDICTS BRAIN RESPONSE TO AMBIGUOUS SOCIAL STIMULI

Allison Jack[1], Jessica J. Connelly[1], James P. Morris[1]; [1]University of Virginia — Oxytocin plays an important role in a variety of social perceptual and affiliative processes. A common single nucleotide polymorphism (SNP) variant in the oxytocin receptor gene (OXTR), rs2254298 (G>A), has been associated with differences in social phenotype and neural endophenotype in both typical and clinical populations. DNA methylation in the first intron of OXTR is increased in autism spectrum disorder, a well known neurodevelopmental condition involving social phenotype. Given these data and the hypothesis that complex disease is a manifestation of extreme typical phenotype, we predicted that assessing the methylation profile of OXTR in the context of rs2254298 in typicals would allow for a more robust characterization of individual differences in social perception. Forty-two healthy adults participated in an fMRI paradgim using classic Heider and Simmel animations in which geometric shapes move and interact in ways that imply animacy. OXTR methylation and rs2254298 genotype interacted to predict participants' response to these ambiguous social stimuli in a number of brain regions important for mentalizing, including superior temporal sulcus, temporal pole, and paracingulate. In particular, carriers of the G allele with greater methylation demonstrated a more effortful, less efficient response to these stimuli. Previously, the GG type has been implicated as at risk for a variety of negative social outcomes, including the development of autism spectrum conditions. However, our data suggest that it is not purely the genotype that confers risk in social-perceptual and mentalizing processes, but the interaction of the genotype with degree of OXTR methylation

D22

EVENT-RELATED POTENTIALS IN RESPONSE TO EMOTIONAL FACES AMONG INDIVIDUALS WITH DIFFERING POLITICAL ATTITUDES

John Garza[1], Karl Giuseffi[1], Kevin Smith[1], John Hibbing[1], Kimberly Andrews Espy[1,2]; [1]University of Nebraska, Lincoln, [2]University of Oregon — Recent studies have found that individuals who hold differing political attitudes (i.e., conservative vs. liberal) can also differ in basic social cognitive processing. For example, emotionally ambiguous face stimuli are rated as displaying threatening emotions more frequently among Republican sympathizers (Vigil, 2010), and gaze cue effects are attenuated among those with conservative ideologies relative to their liberal counterparts (Dodd, Hibbing, & Smith, 2011). We utilized ERP to explore the electrophysiological analogues of these potential differences in emotional face processing. Conservative and liberal leaning participants performed an emotion discrimination task while EEG was recorded. Specifically, participants made a forced choice button-box response of angry, disgust, fearful, or happy response to faces expressing these four emotions in addition to neutral faces. In general, early visual components discriminated among the different emotions and neutral facial expressions. The N1 amplitude was more negative in response to negative emotions relative to happy and neutral, and the latency was earlier to happy faces compared to all other expressions. Preliminary analyses comparing political ideologies

revealed that the latency of the P2 in response to fearful faces was later for conservatives relative to liberals, while it was later for liberal individuals in response to disgust faces. A late (600 msec), post-stimulus offset positivity located over posterior regions of the scalp discriminated between the political ideologies in response to disgust faces, such that the peak amplitude was greater for conservatives relative to liberals. These results are explored further with continuous measures of political ideology and implications are discussed.

EXECUTIVE PROCESSES: Development & aging

D24

THERAPEUTIC POTENTIAL OF ESTRADIOL IN ALZHEIMER'S DISEASE: RESULTS OF A PLACEBO-CONTROLLED, DOUBLE-BLIND, PARALLEL-GROUP DESIGN, INTERVENTION TRIAL Whitney Wharton[1], Laura Baker[2], Carey Gleason[1], Maritza Dowling[1], Jodi Barnet[1], Sterling Johnson[1], Cynthia Carlsson[1], Suzanne Craft[2], Sanjay Asthana[1]; [1]University of Wisconsin Madison, Alzheimer's disease Research Center, [2]University of Washington, School of Medicine, Seattle, Alzheimer's disease Research Center — We aimed to conduct a placebo-controlled, double-blind, parallel-group design intervention study to evaluate the therapeutic efficacy of hormone therapy (HT) in postmenopausal women with mild to moderate Alzheimer's disease (AD). The trial was designed to evaluate the dose-dependent effects of transdermal 17-? estradiol Provera©, unopposed and opposed with medroxyprogesterone (MPA), for 12 months in 43 postmenopausal women with AD. Participants were assessed using cognitive and mood measures at baseline, months 1, 3, 6, and 12 of treatment and eight weeks post treatment (month 15). The dropout rate was 48.8% across 12 months. As a result of the Women's Health Initiative (WHI) and anticipated increased attrition, the protocol was modified such that analyses would be conducted at time points where attrition was less than 30%. Sensitivity analyses concluded that results are robust and reliable up to month 3 of treatment. Results show that 3 months of HT, particularly opposed HT, elicits cognitive benefits across multiple cognitive domains, including visual recent memory, verbal memory, semantic memory and language in postmenopausal women with AD. Moreover, some benefits correlate to increases in estrogen levels. Though there were no differences in mood between opposed vs. unopposed HT groups, participants in the overall treatment group (any HT) exhibited a subjective worsening of mood compared to participants in the placebo group. Results indicate that short-term transdermal estradiol administration enhances aspects of memory in women with AD. Furthermore, cognitive benefits were observed even in the presence of subtle mood complaints.

D25

GENETIC VARIATION MODULATES THE EFFECT OF EXECUTIVE ATTENTION TRAINING IN PRESCHOOL CHILDREN M Rosario Rueda[1], Lina M. Cómbita[1], Pedro M. Paz-Alonso[2], J. Paul Pozuelos[1], Alicia Abundis[1]; [1]Universidad de Granada, [2]BCBL — Recent research has provided evidence that genetic variation is associated with brain structure and function as well as people's cognitive skills. Also, allelic variants of DA-related genes interact with environmental variables to predict aspects of behavior related to self-regulation. We tested Gene x Environmental interactions in the context of an intervention to improve executive control in a group (n=96) of preschoolers. Children were randomly assigned to receive either 8-sessions of computer-based attention training or an equally long control intervention. Genotypes on various DA-related genes (DRD4, DAT1 and COMT) were obtained for each participant. The effect of intervention was evaluated in a set of measures including working memory span, crystallized and fluid intelligence, attention (child ANT task), and emotion-regulation tasks. Intervention was found to produce a significant increase on fluid intelligence. However, this effect was modulated by genetic variation on the DAT1 and COMT genes. The effect of training was significant only for children carrying the 10-repeat variation of the DAT1 gene. Likewise, improvement on fluid intelligence was significantly larger for children carrying the Met variation of the COMT gene. Our data are consistent with previous research showing that particular genetic variations make the individual more susceptible to the influence of experience. Interestingly, variations showing the greater susceptibility to intervention are those associated to higher risk for pathologies involving attention and executive control. Susceptibility to experience provides an opportunity to promote attention control and self-regulation by means of appropriate educational interventions.

D26

ENHANCED EXECUTIVE FUNCTIONING SKILLS IN CHILDREN AND ADULTS WITH MUSICAL TRAINING Jennifer Zuk[1], Christopher Benjamin[1], Arnold Kenyon[1], Nadine Gaab[1,2,3]; [1]Laboratories of Cognitive Neuroscience, Children's Hospital Boston, [2]Harvard Medical School, [3]Harvard Graduate School of Education — Executive functions (EF) are cognitive capacities that allow for purposeful, self-regulated behavior. EF skills strongly correlate with academic abilities and have been shown to be more indicative of school readiness in children than measures of intelligence. Several extracurricular activities have been shown to improve EF skills. To date, the relationship between the extracurricular musical training and EF ability remains unclear. Musical training has been linked to greater academic skills, such as reading ability. Thus, we hypothesized that EF is one of the mechanisms that facilitates the connection between musical training and academic achievement. 27 children and 30 adults with and without extensive musical training were assessed on a standardized battery of EF measures (D-KEFS). No differences in age, IQ, or socio-economic status were observed between the groups. Adult musicians compared to nonmusicians showed better performance on Backward Digit Span and Verbal Fluency. Children with musical training showed better performance on Inhibition, Verbal Fluency and Rule Switching compared to nonmusicians. Additionally, neural correlates of EF (rule representation and task-switching) were examined with fMRI. Children with musical training compared to nonmusicians demonstrate significantly greater activation in prefrontal cortices (preSMA/SMA) during the EF task. Overall we conclude that children and adults with musical training show enhanced EF skills, and children further show enhanced brain activity in bilateral prefrontal cortices during an EF task. These results support our working hypothesis that musical training may support or facilitate the development and maintenance of EF skills which then could lead to improved academic abilities.

D27

RELATING BEHAVIORAL AND ELECTROPHYSIOLOGICAL INDICES OF RESPONSE INHIBITION AND ACADEMIC ACHIEVEMENT IN YOUNG CHILDREN: A DEVELOPMENTAL ERP STUDY Jennie K. Grammer[1], Melisa Carrasco[1], William Gehring[1], Frederick Morrison[1]; [1]University of Michigan — Evidence for relations between children's executive functions (EF) and academic achievement has accumulated steadily in recent years. For example, one component of EF – response inhibition – has been identified as a unique predictor of math achievement and literacy in kindergarten. Although there is also a growing literature describing the electrophysiological correlates of the development of response inhibition using event-related potentials (ERPs), and error related negativity (ERN) more specifically, little is known about linkages between these indices of EF and children's achievement. In this presentation, findings from a school-based investigation, including measures of academic achievement and ERP data drawn from a Go/No-Go task collected in the elementary school setting, will be presented. Results from a preliminary sample of 32 pre-Kindergarten, Kindergarten, and First-Grade children (mean age = 75.6 months), revealed the presence of the ERN on error trials in the Go/No-Go task. Considering the linkages between the ERN and behavioral measures within task, relations were identified between ?ERN (the difference between amplitude on error and correct trials) and children's accuracy ($r = .37$, $p < .05$). In addition, correlations were also found between literacy performance and ?ERN ($r = -.55$, $p < .05$). In con-

trast, behavioral measures including accuracy on the Go/No-Go task were linked to children's math achievement ($r = -.44$, $p < .05$). These and other trends in the relations between behavioral and electrophysiological indices of EF and achievement will be discussed.

D28

IN VIVO 1H MR SPECTROSCOPY IN YOUNG ADULTS WITH MARIJUANA DEPENDENCE Monica Luciana[1], Ryan Muetzel[1], Malgorzata Marjan'ska[1], Mary Petrosko[1], Paul Collins[1], Edward Auerbach[1], Romain Valabrègue[2], Kelvin Lim[1]; [1]University of Minnesota, [2]CRICM (CENIR), Hôpital Pitié-Salpêtrière — Adolescence is a sensitive period of brain development within which substance use can have devastating consequences. For instance, adolescent marijuana use has been associated with adverse behavioral and physiological effects. Yet, relatively little is known about how marijuana impacts brain metabolism. Using MR-spectroscopy directed at the striatal region, we examined major metabolites in daily users versus controls with a focus on glutamate. Twenty-seven marijuana users (11F, mean age 19.5 years) and 26 non-using controls (16F, mean age 19.3 years) were studied. Inclusion criteria for users consisted of 5 days per week of reported use, and use initiation before age 17. Participants completed neurocognitive testing and MR spectroscopy on a 3 tesla MRI system. MR-spectra were obtained in the right basal ganglia using a single voxel and were processed using both in-house and commercially available software. Estimates of metabolite concentrations were quantified relative to total creatine for glutamate+glutamine (Glx), total choline, myo-inositol, and N-acetylaspartate. Users had limited psychopathology, outside of substance use disorders, as assessed by in-person clinical interviews. Users showed significantly lower Glx/tCr compared to controls, independent of age, sex, and alcohol use. Sex interacted with this pattern. Female users had lower estimated concentrations of Glx/tCr than female controls and male users. No other group differences were found. These data are consistent with the literature in suggesting that heavy early-onset marijuana use is associated with abnormalities in excitatory neurotransmitter signaling systems implicated in addiction and further suggest that striatal dysfunction, particularly in females, should be a target of further investigation.

D29

EFFECTIVE NEURAL MARKERS FOR WORKING MEMORY DECLINE: DIFFERENTIATIONS BETWEEN MCI AND NORMAL OLDER ADULTS Juan Li[1], Jing Yu[1], Lucas Broster[2], Charles Smith[3,4,5], Gregory Jicha[3,4], Yang Jiang[2,4,5]; [1]Key laboratory of Mental Health, Institute of Psychology , Chinese Academy of Sciences, [2]Department of Behavioral Science, University of Kentucky College of Medicine, [3]Department of Neurology, University of Kentucky College of Medicine, [4]Sanders-Brown Center on Aging, University of Kentucky College of Medicine, [5]Magnetic Resonance Imaging and Spectroscopy Center — Introduction:To determine whether a match-to-sample ERP is an effective neural marker for differentiating Mild Cognitive Impairment (MCI) from normal older adults. Methods: Eighteen Normal, 16 MCI and 13 Dementia subjects were studied with a match-to-sample task using event-related potentials (ERPs), in which at the beginning of each trial subjects were required to memorize a sample object and then determined whether each of 5 serially presented objects was the same or different from the sample ("match/non-match"). Results: Though dementia patients performed much worse and slower compared to normal and MCI subjects (ps< .05), the later two groups did not differ significantly in terms of behavioral performance. On the right hemisphere match items evoked larger P3, a working memory processing index, than non-match ones. The amplitudes of this positive effect were equivalent in all three groups (p>.05). However, at left hemisphere, a reversed positive pattern was observed in both MCI and dementia groups in that non-match items evoked larger positivity, though this effect did not reach significance in dementia patients. ROC analyses by combing these left & right positive effects provided an 87.5% sensitivity and a 72.2% specificity for identifying MCI from normals. Conclusions: Match-to-sample ERP is an effective neural marker for differentiating MCI from normal older adults even with preserved task performance. MCI brain may involve more processing/regions to compensate their reduced efficiency of dedicated circuits so that they behaved like normal older adults. The compensatory plasticity was reduced in dementia patients who therefore showed more frank cognitive loss.

D30

RATES OF AGE-RELATED COGNITIVE DECLINE AND TRAINING IMPROVEMENT DEPEND ON TASK MODALITY: BASELINE AND TRAINING EFFECTS ACROSS THE LIFESPAN IN A SAMPLE OF OVER 20,000 INDIVIDUALS TRAINING IN FOUR DISTINCT COGNITIVE DOMAINS Kacey Ballard[1], Ben Katz[1], Michael Scanlon[1]; [1]Lumos Labs, Inc. — As age-related cognitive decline affects millions of adults world-wide, targeted cognitive training programs offer new potential for treatment. Existing research shows that the rate of decline depends on task modality: e.g. processing speed and memory span decline early, while verbal fluency and crystallized intelligence remain preserved. However, little is known about how cognitive training improves performance across different domains or how training-related improvements change throughout the lifespan. Aims: The present study investigated (1) whether training can lead to improvements on cognitive tasks throughout the lifespan, and (2) how task modality affects training-related improvements in performance. Methods: We examined baseline performance and training-related improvements in four cognitive domains: working memory, short-term spatial memory span, arithmetic, and verbal fluency, within samples of 20,000 - 80,000 adults ages 15 to 75. Participants trained on an exercise at least 25 times using free online software on Lumosity.com. Results: Results showed that while baseline performance in working memory and spatial memory span declined with age after the teens, arithmetic and verbal fluency remained robust through the thirties and forties. Adults of all ages showed significant improvement on all tasks after training. However, older adults improved more on arithmetic while younger adults improved more on spatial memory span. Discussion: These results demonstrate that while all adults experience significant improvement after training, training confers different levels of improvement depending on age and the modality trained. Implications for training-related transfer of benefits will be discussed.

D31

LOWER EEG INTER-TRIAL PHASE COHERENCE IS RELATED TO HIGHER REACTION TIME VARIABILITY ACROSS THE LIFE SPAN Goran Papenberg[1], Dorothea Hämmerer[1], Viktor Müller[1], Ulman Lindenberger[1], Shu-Chen Li[1]; [1]Max Planck Institute for Human Development, Berlin — Greater intraindividual trial-to-trial reaction time (RT) variability is associated with lower behavioral performance and longitudinal cognitive decline in old age. Across the life span, intraindividual RT variability decreases from childhood to adolescence and increases from young adulthood to old age (e.g., Li et al., 2004). Neural correlates of performance variability have only recently attracted research attention (e.g., MacDonald et al., 2006). Across four age groups, we analyzed event-related delta and theta oscillations assessed during a variant of the continuous performance task entailing the monitoring of NoGo vs. Go cues and inhibition. Consistent with previous findings (Müller et al., 2009), we observed an increase in delta/theta inter-trial phase coherence (ITPC) from childhood to adulthood. To focus on brain activities underlying the monitoring of response conflict rather than activities implicating motor responses, we examined the relationship between performance variability and delta/theta ITPC in the NoGo condition. We consistently found that lower delta/theta ITPC in the NoGo condition was associated with higher trial-to-trial RT variability across the lifespan in children (age 9–11, n = 35), adolescents (age 13–16, n = 43), younger adults (age 20–28, n = 46), and older adults (age 66–76, n = 47). In contrast, delta/theta ITPC was unrelated to mean reaction time in all age groups. These data together with neurocomputational theories (e.g., Li, Lindenberger, & Sikström, 2001) suggest that mechanisms affecting the signal-to-noise

ratio of neural information processing may contribute to individual and age differences in performance variability.

D32

DEVELOPMENTAL DIFFERENCES IN CONFLICT PROCESSING AND TASK-SWITCHING IN SCHOOL-AGED CHILDREN Ayzit O. Doydum[1], Bruce D. McCandliss[1]; [1]Vanderbilt University — Executive functions (EFs) are domain-general processes involved in controlling one's focus, thinking flexibly, and inhibiting impulsive behaviors; however, whether these components are unitary or disparate is still under debate. Functional neuroimaging work indicates neural dissociations between conflict processing and task-set representation and maintenance (MacDonald, 2000; Fassbender, et al., 2004), but investigating how these process develop in children may provide novel insights into potential dissociations between these two neural systems. The present study used computer-based tasks to investigate two forms of EF, conflict processing and task-switching, in a cross-sectional sample of 202 children enrolled in kindergarten through third grade, a period when EFs are dynamically developing (White, 1965; Best et al., 2009). Children engaged in a child-adapted Flanker task (Rueda et al., 2004) and a task-switching game on a touch-screen computer, and reaction time (RT) and accuracy served as dependent measures. Conflict processing improved with grade level, as captured by decreasing RT conflict scores ($p<.05$), with the largest improvement observed between kindergarten and first grade. Task-switching also improved marked by decreases in switch cost in the accuracy domain ($p<.05$). Most importantly, performance on these two tasks was not significantly correlated after controlling for age and overall RT ($p>.1$), suggesting that conflict processing and task-switching are possibly dissociable components of EF developing during the school-aged years.

EXECUTIVE PROCESSES: Working memory

D33

INDIVIDUAL DIFFERENCES IN WM CAPACITY MODULATE THE EFFECT OF TRANSCRANIAL DIRECT CURRENT STIMULATION TO PARIETAL CORTEX Kevin Jones[1], Marian Berryhill[1]; [1]University of Nevada, Reno — The nature of parietal activations in working memory (WM) remains poorly understood. We previously reported that posterior parietal damage impaired WM probed by recognition but not recall (Berryhill et al., 2008). We replicated this unexpected pattern in healthy young adults using cathodal transcranial direct current stimulation (tDCS) of the posterior parietal cortex (P4) prior to WM task performance (Berryhill et al., 2010). However, Tseng and colleagues (2011) reported improvements in a more challenging WM task after anodal tDCS to posterior parietal cortex. Here, we tested whether these conflicting results were modulated by WM task difficulty and participants' WM capacity. In Experiment 1, we applied cathodal and anodal tDCS to the parietal cortex and tested participants on both WM tasks in a within-subject design. The effect of tDCS was modulated by task difficulty and WM capacity. When the WM task was more difficult, tDCS improved WM performance in high WM capacity participants and impaired performance in the low WM capacity. No effect of tDCS was observed in the easier WM task. Experiment 2 was designed to test whether these effects were due to differences in WM task or task difficulty. We modulated difficulty by varying set size (4, 6, 8 items) in a single WM task. Anodal tDCS to the parietal cortex improved performance when the set size was 4, but there was no tDCS benefit when set size exceeded WM capacity. These findings provide important evidence indicating that individual differences and task demands can reveal complementary tDCS effects.

D34

DEACTIVATION OF ITEMS IN WORKING MEMORY CAN WEAKEN LONG-TERM MEMORY Jarrod Lewis-Peacock[1], Kenneth Norman[1]; [1]Princeton University — How does shifting attention away from an item in working memory affect subsequent retention of that item? Neurally, the removal of attention has been shown to deactivate the representation of the unattended item (Lewis-Peacock et al., in press). The nonmonotonic plasticity hypothesis (Newman & Norman, 2010) predicts that sustained moderate activation of a neural representation will lead to weakening of that representation. Therefore, if the neural deactivation process is relatively slow (such that the unattended representation lingers in a moderately active state), this should lead to more forgetting than if the deactivation is relatively fast. To test this prediction, we designed a fMRI experiment to assess whether the rate of neural deactivation correlates with subsequent remembering. Each trial began with the presentation of two target pictures (one face and one scene). Following a brief delay, a cue appeared indicating which one of the targets would be the focus of an upcoming short-term recognition test. On a random 1/3 of the trials, a switch cue appeared at the end of the delay indicating that the previously uncued target would be tested on this trial (after an additional delay). Multivariate pattern analysis of the fMRI data was used to track the time course of deactivation for the uncued target item. Finally, these neural measures were correlated with behavioral performance on a surprise recognition test at the end of the experiment. Preliminary results are consistent with our prediction: items that were deactivated more slowly were less well remembered.

D35

DAT1 POLYMORPHISMS ARE LINKED TO TRAINING INDUCED PLASTICITY IN HEALTHY 4-YEAR OLD CHILDREN Stina Söderqvist[1,2], Sissela Bergman Nutley[1,2], Myriam Peyrard-Janvid[1], Hans Mattsson[1], Keith Humphreys[1], Juha Kere[1,3], Torkel Klingberg[1,2]; [1]Karolinska Institutet, [2]Stockholm Brain Institute, [3]University of Helsinki — Cognitive deficits and particularly deficits in working memory (WM) capacity are common features in neuropsychiatric disorders. Understanding the underlying mechanisms through which WM capacity can be improved is therefore of great importance. Several lines of research indicate that dopamine plays an important role not only in WM function but also for improving WM capacity. For example, pharmacological interventions acting on the dopaminergic system, such as methylphenidate, improve WM performance. In addition, behavioral interventions for improving WM performance in the form of intensive computerized training have recently been associated with changes in dopamine receptor density. These two different means of improving WM performance, pharmacological and behavioral, are thus associated with similar biological mechanisms in the brain involving dopaminergic systems. Data is presented here, showing that variation in the dopamine transporter gene (DAT1) influences improvements in WM and fluid intelligence in preschool aged children following cognitive training. Our results emphasize the importance of the role of dopamine in determining cognitive plasticity.

D36

NEURAL CORRELATES OF IMPAIRED CONTROL OVER WORKING MEMORY IN SCHIZOPHRENIA Teal S. Eich[1], Derek N. Nee[2], Catherine Insel[1], Cara Malapani[3], Edward E. Smith[1,3]; [1]Columbia University, [2]Indiana University, [3]New York State Psychiatric Institute — We investigated cognitive control deficits in patients with schizophrenia (SCZ), focusing on inhibitory processes in working memory (WM). We have previously shown that patients with SCZ demonstrate a selective impairment in suppressing irrelevant information from WM. Here, we explore the neural underpinnings of this impairment. While being scanned with fMRI, healthy controls (HC) and patients with SCZ performed a WM task in which a memory-set consisting of 2 red and 2 blue words was presented. This was followed by a brief delay, after which participants were given a cue to remember only the red or blue words and suppress the other two words from WM. Participants were then given a test probe that either matched one of the two target words (Valid), matched a word that was to-be-suppressed from WM (Lure), or had not been presented (Control). Compared to HCs, SCZs showed increased activation in the left mid-VLPFC (BA 45) when responding to Lure as compared to Control probes. This region has previously been implicated in resolving proactive interference in memory. HCs also showed activation reductions in

left posterior VLPFC (BA 44/6) and other perisylvian regions following the remember cue, commensurate with appropriately ridding WM of irrelevant content. In contrast, SCZs did not show perisylvian WM-related reductions. Collectively, these data suggest that patients with SCZ fail to efficiently suppress information from WM leading to subsequent difficulties during retrieval.

D37

EFFICIENCY FOLLOWING VISUAL SPATIAL WORKING MEMORY TRAINING: INCREASES IN DEFAULT MODE AND DECREASES IN FRONTAL PARIETAL ACTIVATION. Sharona M. Atkins[1], Donald J. Bolger[1], Michael R. Dougherty[1], Michael F. Bunting[1]; [1]University of Maryland — Working memory is a capacity limited cognitive process involved in the active maintenance and manipulation of task relevant information. Research has recently suggested that it is possible to improve working memory following adaptive training. We administered 10 hours of either visual-spatial working memory (vsWM) training (n=18), or an active control training (n=17), to examine the changes in neural activation following the vsWM training. An assessment battery containing cognitive behavioral tasks and a vsWM training task while undergoing functional magnetic resonance imaging (fMRI) scanning were administered at pre-training and post-training. Relative to the active control group, participants in the vsWM training group displayed improvements in training and the behavioral transfer tasks involving visual-spatial executive functions. Training-related changes in the fMRI blood oxygen level dependence (BOLD) contrast for task performance were evident in the high-load (5 to 7 stimuli) condition but not the low-load (2 to 4 stimuli) condition, suggesting enhancements to capacity. BOLD contrast differences between groups comparing post-training and pre-training activity revealed reduced activation for the vsWM training group in the frontal-parietal network bilaterally, and increased activation in regions associated with "the default mode network". These results lead us to conclude that vsWM training leads to greater efficiency in the neural activation for the trained vsWM task.

D38

WORKING MEMORY TRAINING GAINS AND TRANSFER TO OTHER COGNITIVE FUNCTIONS Kathryn Gigler[1], Paul Reber[1]; [1]Northwestern University — Recent research demonstrating improvements in working memory (WM) capacity has challenged the idea that WM capacity is an immutable cognitive trait. Indeed, relatively modest training protocols have been shown to lead to significant improvement. Because WM is a core cognitive process, increasing capacity has the potential to enhance performance on a wide range of cognitive functions. A critical question is the degree to which gains exhibited on the WM training task transfer to other cognitive processes. To test for transfer, the CogState cognitive assessment battery was completed by participants both before and after 10 hours of WM training with a novel training protocol. The CogState assessment battery includes a collection of tests that measure long-term memory function, executive function, attention and processing speed. During training, participants completed 2000 training trials of a visuospatial working memory task. Each trial consists of two phases: the presentation phase, during which participants see a sequence of moving visual cues and must hold that sequence in WM, and the response phase, during which participants attempt to replicate the sequence. The training is adaptive, adjusting the length of presented sequences based on performance in order to keep training near each individual's WM span. Participants showed reliable improvement in WM span on both the trained task and a separate, non-trained assessment of visuospatial WM. Significant improvements were also observed on CogState measures of non-verbal long-term memory, attention, and processing speed, indicating that WM training can produce considerable gains in cognitive functioning beyond merely domain-specific WM improvement.

D39

INFLUENCE OF DISTRACTION ON WORKING MEMORY AND PREFRONTAL CORTEX ACTIVITY IN CHILDREN WITH ADHD Satoshi Tsujimoto[1], Akira Yasumura[2], Yushiro Yamashita[3], Makiko Kaga[2], Masumi Inagaki[2]; [1]Kobe University, [2]National Center of Neurology and Psychiatry, [3]Kurume University School of Medicine — Children with attention deficit hyperactivity disorder (ADHD) tend to be sensitive to interference and distraction, which is thought to lead to the disruption of working memory particularly for visuospatial information. To study the effect of distraction on their working memory and its underlying neural mechanisms, we recruited 20 ADHD children and 16 typically developing control children. They performed a visuospatial working memory task, involving recall of spatial locations after a delay period with two conditions: the experimental condition required a secondary (distractor) task during the delay period, whereas the control condition did not have any systematic distraction. While the children performed the task, we recorded hemodynamic changes in the lateral prefrontal cortex using a near-infrared spectroscopy imaging. At the behavioral level, ADHD group showed significantly lower performance than the control group (overall correct recall rate: 74% vs. 87%, $p<0.01$), and, as expected, ADHD children showed particularly poor performance in the experimental condition (65% vs. 83% for ADHD and control group, respectively). Furthermore, the performance of ADHD children in the experimental condition was significantly correlated with the score of rating scale for ADHD ($r=0.79$, $p<0.001$). Brain activity also showed between-group differences. In particular, the control group tended to show change in activity during the delay period more clearly than the ADHD group. Further, the ADHD group showed tendency to modulate their activity in right prefrontal cortex compared to the control group. We conclude that these characteristic activity patterns in the prefrontal cortex may underlie the ADHD's susceptibility to the distraction.

D40

WORKING MEMORY DEVELOPMENT LINKS MAOA POLYMORPHISM TO AGGRESSIVE BEHAVIOR Tim Ziermans[1], Iroise Dumontheil[1,3], Chantal Roggeman[1], Myriam Peyrard-Janvid[1], Hans Matsson[1], Juha Kere[1,2], Torkel Klingberg[1]; [1]Karolinska Institutet, Sweden, [2]Haartman Institute, University of Helsinki, Finland, [3]University College London, UK — A developmental increase in working memory (WM) capacity is an important part of cognitive development and low WM capacity is a risk factor for developing psychopathology. Brain activity is a promising intermediate phenotype for linking genes to behavior and for improving our understanding of the neurobiology of WM development. We investigated gene-brain-behavior relationships by focusing on 18 single nucleotide polymorphisms (SNPs) located in six dopaminergic candidate genes (COMT, SLC6A3/DAT1, DBH, DRD4, DRD5, MAOA). Visuospatial WM (VSWM) brain activity, measured with functional magnetic resonance imaging (fMRI), and VSWM capacity were assessed in a longitudinal study of typically developing children and adolescents. Behavioral problems were evaluated using the Child Behavior Checklist (CBCL). One SNP (rs6609257), located ~ 6.6 kb downstream of the monoamine oxidase A gene (MAOA) on human chromosome X, significantly affected brain activity in a network of frontal, parietal and occipital regions. Increased activity in this network, but not in caudate nucleus or anterior prefrontal regions, was correlated with VSWM capacity, which in turn predicted externalizing (aggressive / oppositional) symptoms, with higher WM capacity associated with fewer externalizing symptoms. There were no direct significant correlations between rs6609257 and behavioral symptoms. These results suggest a mediating role of brain activity and WM capacity in linking the MAOA gene to aggressive behavior during development.

D41

SOURCE LOCALIZATION OF EEG SIGNALS GENERATED DURING SEQUENCE LEARNING AND EXPECTATION MONITORING Abigail Noyce[1], Robert Sekuler[1]; [1]Brandeis University — To characterize the neural responses that reflect subjects' (i) sequence learning, and (ii) detection of events that deviate from a familiar sequence, we asked subjects to learn novel visuomotor sequences. In our task, subjects viewed a disk that traversed a quasi-random path comprising five linear motion segments, and then tried to reproduce the disk's trajectory from memory. The fidelity of subjects' imitations improved over four presentations of each such sequence. A high-density EEG system recorded scalp electrical activity while subjects observed the disk's movements. ERPs to disk motion offset (at the pauses between trajectory segments) showed a large decrease in amplitude from the first presentation to later repetitions; ERPs to motion onset of each segment showed a smaller decrease. Using sLORETA and a realistic head model, the EEG signal sources associated with these changes in ERP amplitude were localized to left-lateralized fronto-temporal areas, despite the visuospatial nature of our task. During the final presentation of a sequence, we occasionally changed the direction of one trajectory segment, disconfirming subjects' expectations about the disk's movement. When we compared neural responses to standard versus deviant sequence items, we found a late, positive-going ERP component that localized to the cingulate cortex. As this component's timing and localization matches those produced by response errors to discrete motor tasks, we propose that the mechanisms that monitor the validity of sensory expectations are similar to those that monitor response correctness.

D42

DECODING ATTENDED VS. UNATTENDED INFORMATION IN WORKING MEMORY Joshua LaRocque[1], Bradley R. Postle[1]; [1]University of Wisconsin, Madison — Many studies have examined delay-period activity associated with information storage, but most confound information storage with the focus of attention. A recent fMRI study (Lewis-Peacock et al., in press) dissociated attention from working memory storage by cuing participants to attend to one of two items being held in working memory. Information related to the uncued stimulus, assayed by highly sensitive multivariate pattern analyses (MVPA), dropped to baseline, though participants still were able to respond correctly to a subsequent memory probe for the uncued item. This finding suggests that delay-period neural activity reflects the focus of attention rather than the contents of working memory. A possible objection is that fMRI may be insensitive to the neural signal of an unattended but remembered item. To address this concern, an EEG study was performed using the same retrospective cuing design. On each trial, participants remembered two target items drawn from two of three categories: semantic (a noun), phonological (a pronounceable nonword), and visual (one target item = two oriented line segments). MVPA was applied to a time-frequency representation of EEG data from the pre-cue and post-cue delay periods. Though the MVPA could decode the categories of both items being remembered in the pre-cue delay period, the post-cue analyses were only sensitive to the category of the cued item. These results support the conclusion that information in working memory but outside the focus of attention is stored passively, and only information in the focus of attention is actively maintained.

LANGUAGE: Lexicon

D43

CHINESE CHARACTER IDENTIFICATION: NEURAL EVIDENCE FOR ORTHOGRAPHIC ANALYSIS Chiao-Yi Wu[1], S.H. Annabel Chen[1], Kayako Matsuo[2], Wen-Yih Isaac Tseng[2], Chih-Wei Hue[2]; [1]Nanyang Technological University, Singapore, [2]National Taiwan University, Taipei, Taiwan — The current study investigated neural representations underlying Chinese character identification. This is a 2-step process in which readers (1) examine orthographic legality of visual scripts (i.e. orthographic analysis) and then (2) search for matched lexical representations in the mental lexicon. Two groups of right-handed healthy participants performed an event-related task, which consisted of four conditions (high-frequency characters, low-frequency characters, pseudo characters, and non-characters), within a 3T scanner. One group (N=17; 6 males) was asked to judge whether the visual stimuli were real characters (lexical decision, LD) and the other group (N=16; 8 males) was instructed to respond whether they recognized the stimuli (lexical recognition, LR). Both instruction formats were thought to evoke the 2-step character identification process while LD engaged more orthographic analysis. Behavioral performance was significantly different among conditions ($p < 0.05$). A two-way mixed factorial analysis (SPM8) revealed significant main effects for instruction and condition while controlling for behavioral performance ($p < 0.001$, uncorrected). Pseudo and non-characters were found to recruit greater activity in the right fusiform gyrus in LD than LR. Non-characters showed more activation in the left fusiform gyrus as compared with high-frequency and low-frequency characters. The bilateral fusiform gyri activation might be attributed to more demanding orthographic analysis in LD and sensitive to orthographic irregularity in non-characters. Overall, LD evoked greater activity than LR. The results confirmed the engagement of the bilateral fusiform gyri in reading Chinese characters, suggesting its contribution to orthographic analysis in detecting orthographic illegality.

D44

NEURONAL INTERACTIONS FOR WORDS AND PSEUDOWORDS DURING LEXICAL DECISION Aneta Kielar[1], Jennifer Mack[1], Aya Meltzer-Asscher[1], Eisha Wali[1], Cynthia Thompson[1]; [1]Northwestern University — Previous studies demonstrated that lexical decision to pseudowords, compared to words, elicits greater activation in the left inferior frontal gyrus (IFG), reflecting increased phonological processing and lexical search (Heim et al., 2005), whereas words elicit greater activation in the left angular gyrus (AG), reflecting semantic processing (Binder et al., 2005). The present study investigated effects of word type on the neural network supporting lexical decision using dynamic causal modeling (DCM). fMRI was used to measure participants' neural responses during a visual lexical decision task. Consistent with previous studies, we found stronger activation in the left AG for words and in left BA 44, BA 47, and fusiform gyrus (FG) for pseudowords. The DCM study compared four models with different connections modulated by word type. All models contained bidirectional intrinsic connections between all four regions, with words and pseudowords serving as driving inputs to the FG. In the best fitting model, pseudowords strengthened the connection from FG to BA 47, whereas words negatively modulated this connection and that from BA 47 to BA 44. This model is consistent with the proposal that left BA 47 guides lexical search, BA 44 supports phonological processing, and (a portion of) the FG supports initial lexical processing (Hillis et al., 2005). It further suggests that phonological processing is sensitive to task demands, and is suppressed once a word is identified (Coltheart et al., 1993). There were no significant modulatory connections involving the AG, suggesting that semantic processing is not an integral part of lexical decision.

D45

AN ELECTROENCEPHALOGRAPHIC INVESTIGATION ON THE EFFECTS OF LATE BILINGUALISM ON NATIVE LANGUAGE PROCESSING Nathaniel Shannon IV[1], Sharlene Newman[1], Steven Green[1], Evguenia Malaia[1]; [1]Indiana University - Bloomington — This EEG study investigated the effect of late acquisition of Spanish (L2) on reading native English words. Two groups of native English participants – one with very limited Spanish experience and one with extensive experience. The participants performed two lexical decision tasks: an English lexical decision task (ELD), in which the participants indicated whether a letter string was an English word; and a General lexical decision task (GLD), in which the participants indicated whether a letter string was a word in either English or Spanish. Orthographic similarity was also manipulated such that the spellings were either similar (O+) or dissimilar (O-) across languages. Behavioral results

demonstrated a faster reaction time to word vs. non-word stimuli in both groups, with O+ stimuli eliciting fastest RTs. Statistical analysis of the amplitude and latency of the P2 component revealed significant differences between the processing of O+ vs. O- stimuli in bilinguals. N2 amplitude and latency were affected by language as well as the task in the monolingual group, but only the task in bilingual group, while P3 amplitude and latency was modulated by task in both groups. The results suggest that late bilinguals draw on a combined lexicon of both languages during word recognition (which increases the number of orthographic neighbors for individual words). The results also appear to support the Bilingual Interactive Model+, confirming that orthographic and phonological representations of visually presented words are activated simultaneously for both known languages even in late bilinguals.

D46

COMPETITION AND COOPERATION AMONG SIMILAR REPRESENTATIONS: A UNIFIED ACCOUNT OF FACILITATIVE AND INHIBITORY EFFECTS OF LEXICAL NEIGHBORS Qi Chen[1], Dan Mirman[1]; [1]Moss Rehabilitation Research Institute — One of the core principles of how the mind works is the graded, parallel activation of multiple related or similar representations. Parallel activation of multiple representations has been particularly important in the development of theories and models of language processing, where co-activated representations ("neighbors") have been shown to exhibit both facilitative and inhibitory effects on word recognition and production. Researchers generally ascribe these effects to interactive activation and competition, but there is no unified explanation for why the effects are facilitative in some cases and inhibitory in others. We present a series of simulations of a simple domain-general interactive activation and competition model that is broadly consistent with more specialized domain-specific models of lexical processing. The results showed that interactive activation and competition can indeed account for the complex pattern of reversals. The simulations also made a novel and counterintuitive prediction, which was tested and confirmed with re-analysis of behavioral data. Critically, the simulations revealed a core computational principle that determines whether neighbor effects will be facilitative or inhibitory: strongly active neighbors exert a net inhibitory effect and weakly active neighbors exert a net facilitative effect.

D47

WORD STRESS AND PHONEME PROCESSING IN CONGENITALLY BLIND ADULTS Ulrike Schild[1], Brigitte Roeder[1], Claudia Friedrich[1]; [1]University of Hamburg — It has been shown that blind adults process spoken language input more efficiently than sighted individuals. Here we tested how blind individuals process two distinct properties of the spoken language input, namely word stress and phonemes. Seventeen congenitally blind adults participated in an auditory fragment priming experiment. German target words were either stressed on their first syllable (e.g., ALter [Engl. age]; capital letters indicate stress), or on their second syllable (e.g., alTAR [Engl. altar]). Each target word was either preceded by a stressed syllable (e.g., 'AL') or by an unstressed syllable (e.g., 'al'). The overlap in word stress and phonemes between syllable and target word (e.g. AL-ALter, KOS-ALter, al-ALter, kos-ALter) was independently manipulated. Both phoneme overlap and stress overlap facilitated lexical decisions in blind participants. The finding of robust behavioral stress priming contrasts to previous results with sighted adults, which only indicated phoneme priming. Event Related Potentials (ERPs) reflected separate phoneme priming and stress priming in blind participants. These results are further evidence for independent neural processing pathways for phonemes and word stress in spoken language comprehension: Evidence for both independent neural processing of phonemes and word stress has already been obtained in sighted individuals. Thus it seems that both processing pathways develop independent of the visual system. However, how efficiently the information about word stress is used during spoken language comprehension appears to depend on the specific needs and is thus subject of language experience.

D48

NEURAL BASIS OF CROSS-MODAL LEXICAL PROCESSING IN CHINESE Yuan Deng[1], Qiu-yan Wu[1], Xuchu Weng[2]; [1]Institute of Psychology, Chinese Academy of Sciences, [2]Hangzhou Normal University — Neuroimaging studies suggest that cross-modal lexical processing evokes activations not only in regions specific to input modality and target modality, but also those regions responsible for cross-modal conversion. However, the existence of grapheme-to-phoneme correspondence rules may be a major confounding variable in the previous studies. Therefore, current study took advantage of Chinese to exclude this confound. By using functional magnetic resonance imaging (fMRI) technique, current study aimed to explore 1) the neural basis for cross-modal lexical processing in Chinese; and 2) to examine the top-down modulation effects of processing level on ventral pathway. Using Chinese single-character words, participants were asked to make two levels of phonological judgments (tone and vowel) to visually presented words and make two levels orthographic judgments (stroke and structure) to auditorily presented words. Imaging results showed that visual-based tasks selectively activated the left superior parietal region; while auditory-based tasks selectively activated the left inferior parietal region. Both tasks evoked similar activation pattern in the left angular gyrus and pre-frontal region. Surprisingly, level of processing did not show significant modulations on the activation of two region-of-interests (ROI) in the ventral pathway that are specific for visual word-forms processing. Current findings suggest that cross-modality lexical processing of Chinese involved both language-specific and language-general brain regions. Dorsal and ventral parietal regions play different roles in the conversion between orthography and phonology in Chinese. Moreover, the top-down modulation of processing levels may happen to a higher regions rather than to the ventral pathway during the cross-modal processing.

D49

THE REPRESENTATION OF HOMOPHONES IN THE PRODUCTION LEXICON: EVIDENCE FROM PICTURE NAMING IN APHASIA Erica Middleton[1], Myrna Schwartz[1]; [1]Moss Rehabilitation Research Institute — This study uses data from neurological patients to address a long-standing controversy regarding how homophones (e.g., bee/be) are represented and retrieved during spoken word production. Word production is known to be a multi-stage process, where the selection of a word's entry from the mental lexicon (lexical-semantic entry) precedes retrieval of its constituent sounds (lexeme). Homophones (e.g., bee/be) have distinct lexical-semantic entries, but controversy surrounds whether homophones access the same lexeme (e.g., /bi/) during word production. Capitalizing on an established finding that a word's frequency of use in language primarily localizes to and impacts lexeme (rather than lexical-semantic) retrieval, the word-frequency inheritance (WFI) effect provided early support for the shared-lexeme view: low-frequency homophones (e.g., bee) were facilitated by their high-frequency homophonic counterparts (e.g., be) and behaved like high-frequency control words in production reaction times and accuracy. However, the WFI effect has not always replicated. In keeping with the WFI effect, we found that that speakers of aphasia whose naming impairment stemmed from difficulty with lexeme retrieval demonstrated facilitated naming of low-frequency homophones (i.e., homophones behaved like high-frequency rather than low-frequency control words in accuracy). Furthermore, speakers with aphasia whose naming impairment stemmed from difficulty with lexical-semantic retrieval showed impaired naming of low-frequency homophones relative to high-frequency control words. The results support the shared-lexeme view and an interactive approach to word retrieval: facilitated naming of "bee" from the WFI effect can be masked by deleterious competition with "be" during lexical-semantic retrieval, which is made possible via interactive activation through a shared lexeme.

D50

BEHAVIORAL AND ELECTROPHYSIOLOGICAL MEASURES OF SENSE RELATEDNESS EFFECTS IN MONOLINGUAL AND BILINGUAL YOUNG ADULTS Vanessa Taler[1,2], Shanna Kousaie[1,2], Chloé Corbeil[1,2], Christianne Laliberté[1,2], Jessica Kumar[1,2], Rocío López Zunini[1,2]; [1]University of Ottawa, [2]Élisabeth Bruyère Research Institute — Previous research indicates that words with many related senses (e.g., "class") are easier to process, eliciting shorter response times (RT) and less neural activation than words that with few related senses (e.g., "sword"). However, it remains unknown whether this "sense relatedness advantage" holds in bilinguals, whose reduced experience in either language relative to matched monolinguals leads to alterations in the pattern of lexical processing. In the current investigation, monolingual (n=4) and bilingual (n=5) participants made a lexical decision to words with many or few related senses while electrophysiological recording took place. Behaviourally, preliminary results revealed a Language Group x Condition interaction ($F(2,14)=4.38$, $p=.04$) demonstrating that bilinguals responded faster to real words than to pseudowords, irrespective of the number of related senses, whereas monolinguals did not show a condition effect. The preliminary analysis of electrophysiological results did not reveal any significant differences due to a lack of power. However, inspection of the N400 time window indicates similar N400 amplitudes for words with many and few related sense in the bilinguals, whereas the monolinguals show a larger N400 amplitude in response to words with few relative to many related senses. These results suggest that, despite similar behavioural performance across conditions, monolinguals benefit from the greater semantic information available in words with many related senses. Bilinguals, in contrast, do not appear to benefit from additional semantic information to the same extent as monolinguals, possibly due to weaker links between lexical and semantic information in bilinguals' mental lexicon.

D51

ROLE OF EMOTIONAL INFORMATION IN ACCESSING THE MENTAL LEXICON: ERP EVIDENCE FROM AFFECTIVE PRIMING Weilin Shen[1], Nicole Fiori[1], Frederic Isel[1]; [1]Paris Descartes University, France — The present study investigated the role of emotional information in accessing the mental lexicon by combining affective priming and electroencephalography. Sixteen right-handed native speakers of French completed an evaluative categorization task on target words (i.e. pleasant vs. unpleasant), which were affectively congruent (sun-MARRIAGE) or not (cancer-MARRIAGE) with the preceding prime word. Using event-related brain potentials (ERPs), the predictions of two alternative theoretical models of affective priming, i.e. the spreading activation model in semantic network and the response competition model were tested. A larger N200 effect was found in response to the processing of affectively incongruent trials in comparison with the congruent ones. This component is assumed to reflect competing responses between the tendency of response induced by the prime and the expected response for the target. Critically, we observed a frontal N400, whose amplitude was modulated by the congruence of emotional valence. Moreover, the N400 effect was larger for negative target words than for positive ones suggesting that access was more difficult for negative than for positive words. Furthermore, the observation of a late positive potential (LPP) distributed over the posterior electrodes was thought to reflect an increased engagement of attentional resources during the processing of emotionally non-congruent word pairs. Taken together, the present findings suggest that the access to the mental lexicon could be modulated by emotional information related to words. Our ERP data lend support to a neurocognitive model of spreading activation in the semantic network including a mechanism of response competition with respect to the emotional valence.

D52

ROLE OF INSULAR CORTEX IN LANGUAGE LATERALIZATION Christine Chiarello[1], David Vazquez[1], Adam Felton[1], Christiana Leonard[2]; [1]University of California, Riverside, [2]University of Florida, Gainesville — An accumulating body of evidence suggests the left anterior insular cortex is implicated in language function. Lesions in this area produce severe deficits in language production (Dronkers, 1996), and functional imaging studies frequently report insular activation for language tasks. Recently, Keller, et al (2011) provided evidence from a highly selected population (N = 25) that structural asymmetry of the insula, but not classical language areas, predicted asymmetry of functional activation during a word generation task. Here, data from the Biological Substrates for Language Project (N = 200) explored the association of insular asymmetry with divided visual field measures of visual language processing. Surface area measures (FreeSurfer v 4.5) of left and right cortex were used to estimate asymmetry of anterior and posterior insular regions, pars triangularis, pars opercularis, and planum temporale. Reliable leftward asymmetries were observed for the anterior insula, pars triangularis, pars opercularis, and planum temporale, for both mixed and consistent handers. However, the anterior insula was the only region whose asymmetry significantly correlated with composite visual field asymmetries. This association was observed for individuals with consistent hand preferences (N = 103, r = +.35, p<.001), but not those with mixed hand preferences (N = 97, r = +.08, p=.45). These data contribute to an emerging consensus that the anterior insula is an important component of the left hemisphere language network. Further, individual differences in asymmetry of this region may be more important for functional language lateralization than asymmetry in classical language areas.

D53

BRAIN ELECTRIC SIGNATURES OF AUDITORY WORD RECOGNITION: SUCCESS, EFFORT, AND CONFLICT Antje Strauss[1], Sonja A. Kotz[1], Jonas Obleser[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Auditory word recognition is often described as a linear process of lexical access. Commonly, however, the perceptual evidence is ambiguous (mishearings, slip of the tounges, etc.), and requires additional compensatory and re-evaluatory processing. We used a lexical decision task in an electroencephalography (EEG) study and manipulated lexico-semantic access by parametrically varying the factor "wordness": Stimuli were three-syllabic German words ("real"), pseudowords derived by only exchanging the core vowel in the second syllable ("recoverable" pseudowords), and pseudowords derived by scrambling entire syllables ("opaque" pseudowords). While listeners performed the lexical decision very accurately (accuracy for all conditions > 95 %), time-locked potentials (ERPs) at the third syllable revealed successive peak delay and amplitude height of the following negative deflection (N400) dependent on wordness; the N400 response to opaque pseudowords was strongest and peaked latest. At and after stimulus offset, alpha power (9 -- 13 Hz) was suppressed as a monotonic function of wordness (real < recoverable < opaque) with stronger suppression indicating less effort in lexico-semantic access. Simultaneously, however, theta power (3 -- 5 Hz) was most enhanced for recoverable pseudowords; they closely resemble a word, but also provide contradicting perceptual evidence (the altered vowel). This led to response conflict and increase in cognitive control. Accordingly, source localisation indicated that theta power changes emerged from the dorsal Anterior Cingulum (dACC). The results show that auditory word comprehension requires a cascade of evoked (N400) and induced (alpha, theta) brain processes, which reflect success, effort, and conflict in lexical access.

LONG-TERM MEMORY: Development & aging

D54

INTER-INDIVIDUAL VARIABILITY IN CRITERION SHIFTING ACROSS THE LIFESPAN Brian Lopez[1], Craig Bennett[1], Tyler Santander[1], Michael Miller[1]; [1]University of California, Santa Barbara — A critical aspect of recognition memory is the integration of available memory evidence and a decision criterion. Previous work has shown that a wide range of factors can affect the placement of a decision criterion, including cognitive and personality factors. In this study we attempted to quantify the impact of aging on criterion placement during episodic recognition. To that end, we used fMRI to examine recognition behavior and regional brain activity in 30 young adults (25-35 yrs) and 30 elderly subjects (60-75 yrs) during a task involving criterion shifting. Subjects were first asked to encode 150 words for later recognition. The words were then presented alongside new, unobserved words in conditions of high target probability (70% old, 30% new) and low target probability (30% old, 70% new). Subjects had to decide for each word whether it was a target old word or a non-target new word. The results demonstrated that target discrimination ability (d-prime) was lower in the elderly group, and that the elderly group showed increased variability in the degree of criterion shifting between the two probability conditions. We also found that the elderly group had significantly increased inter-individual variability in regional brain activity relative to the young adult group while performing the task. The results suggest that aging is associated with increased variability in criterion shifting and in the regional brain activity that accompanies such criterion shifts.

D55

THE CONTRIBUTION OF BLOOD SERUM BIOMARKERS TO THE PREDICTION OF COGNITIVE DECLINE BY FMRI AND APOLIPOPROTEIN-E IN HEALTHY OLDER ADULTS Kristy A. Nielson[1,2], Michael A. Sugarman[3], John L. Woodard[3], Michael Seidenberg[4], J. Carson Smith[5], Sally Durgerian[2], Stephen M. Rao[6]; [1]Marquette University, [2]Medical College of Wisconsin, [3]Wayne State University, [4]Rosalind Franklin University of Medicine and Science, [5]University of Maryland, [6]Cleveland Clinic — Biomarkers are a promising approach to the prediction and early intervention of Alzheimer's disease. We demonstrated that cortical functional MRI (fMRI) activation during a semantic memory task and apolipoprotein-E ?4 allele inheritance (APOE?4) effectively predicted cognitive decline after 18-months in healthy, asymptomatic elders. Hippocampal volume added modest prediction, while AD family history and demographics were ineffective. Previous studies have linked plasma homocysteine (tHcy), vitamin B12 and creatinine values to cognitive functioning, cortical atrophy, hippocampal atrophy and neuropathology, and vascular integrity. Here we incorporated total plasma homocysteine (tHcy), B12 and creatinine values into our previous predictive models. Of 78 healthy elders, 27 (34.6%) exhibited significant cognitive decline after 18-months. tHcy, but not B12 or creatinine, was marginally positively correlated with cortical semantic memory fMRI activation, particularly in stable participants. Logistic regression showed that tHcy, when added to APOE?4 and cortical fMRI, was a significant predictor of outcome and strengthened the already significant model ($p = .007$; $C = .80$ and $R2 = .37$). However, control for B12 and creatinine covariates diminished tHcy as a predictor ($p = .084$), though the model was still stronger than without this factor ($C = .78$ and $R2 = .31$). tHcy did not significantly interact with APOE?4, as has previously been reported. Neither B12 nor creatinine was similarly effective as a predictor. These results suggest that commonly investigated blood serum biomarkers are at best weakly associated with predicting age- and dementia-related cognitive decline in healthy, asymptomatic elders. fMRI and APOE?4 presently provide the best predictive model.

D56

EPISODIC MEMORY MEASURES COMPLEMENT STRUCTURAL AND FUNCTIONAL MRI FOR PREDICTING COGNITIVE DECLINE IN APOLIPOPROTEIN E ?4 CARRIERS John L. Woodard[1], Michael Seidenberg[2], Kristy A. Nielson[3,5], Michael A. Sugarman[1], J. Carson Smith[4], Sally Durgerian[5], Alissa M. Butts[3], Melissa A. Lancaster[2], Mary K. Foster[6], Nathan C. Hantke[3], Monica A. Matthews[2], Stephen M. Rao[6]; [1]Wayne State University, [2]Rosalind Franklin University, [3]Marquette University, [4]University of Maryland, [5]Medical College of Wisconsin, [6]The Cleveland Clinic — Apolipoprotein E (APOE) ?4 allele carriers demonstrate greater risk for cognitive decline and Alzheimer's disease than non-carriers. However, factors associated with risk of decline among APOE ?4 carriers are not well-known. In this longitudinal study, we investigated whether discrete aspects of baseline episodic memory performance and structural (sMRI) and functional (fMRI) magnetic resonance imaging were associated with cognitive decline in older APOE ?4 carriers and non-carriers. Seventy-eight healthy older adults underwent cognitive testing at baseline and after 18 months, baseline serum APOE genotyping, manually-traced hippocampal volume measurement from sMRI, and task-activated fMRI. Cognitive decline was defined as a one SD or greater reduction from baseline on at least one of three cognitive measures at follow-up (Rey Auditory Verbal Learning Test [AVLT] Delayed Recall and Trials 1-5 Sum, Mattis Dementia Rating Scale-2 Total Score). Declining APOE ?4 carriers ($n=14$) exhibited reduced hippocampal volume ($p<.009$) and fMRI semantic processing activity in cortical ($p<.04$) and hippocampal ($p<.05$) regions relative to stable carriers ($n=12$). On the AVLT, declining APOE ?4 carriers showed greater baseline susceptibility to retroactive interference ($p<.006$), intertrial forgetting (lost access; $p<.001$) and recognition false alarms ($p<.05$) compared to stable carriers. Stable ($n=39$) non-carriers showed slightly more susceptibility to proactive interference than declining ($n=13$) non-carriers ($p<.02$). Along with sMRI and fMRI, AVLT measures of rapid forgetting can help to identify APOE ?4 carriers with elevated risk for cognitive decline. These effects appear to be largely unique for APOE ?4 carriers, perhaps due to preclinical structural and functional alterations in structures subserving memory.

D57

ITEM AND ASSOCIATIVE MEMORY FOR NOVEL NATURALISTIC ACTIONS IN AMNESTIC MILD COGNITIVE IMPAIRMENT, OLDER ADULTS, AND YOUNGER ADULTS David A. Gold[1,3], Norman W. Park[3], Angela K. Troyer[2,3,4], Kelly J. Murphy[2,3,4]; [1]Joseph and Kathleen Bryan Alzheimer's Disease Research Center, Duke University Medical Center, [2]Baycrest Centre, [3]York University, [4]University of Toronto — Most research examining associative memory has focused on memory for non-naturalistic, laboratory-based stimuli. We extend current findings by exploring item and associative memory for novel naturalistic actions (NNA; e.g., how to make an arts-and-crafts style project such as a windspeed indicator). Based on previous research using laboratory tasks, a selective decline in memory for associative information (e.g., was this tool used with this object?) relative to item information (e.g., was this object presented?) was predicted in amnestic mild cognitive impairment (aMCI) and aging. Individuals with aMCI ($n = 24$), age-matched older adults ($n = 24$), and undergraduates ($n = 32$) viewed two 90 second NNA videos. Following a 90 second distractor task, participants completed forced-choice recognition memory tests of item and associative memory for the NNAs. A mixed ANOVA with the within-subjects factors of question type (item, associative) and response type (hits, false alarms), and the between-subjects factor of group (young, old, aMCI), revealed no significant interaction [$F(2, 77) = 0.870$, $p = .233$], contrary to previous findings with other stimuli that demonstrates older adults, and those with impaired memory, show selective decline in associative memory. A response type by group interaction confirmed the aMCI group had higher false alarms overall [$F(2, 77) = 20.797$, $p < .001$, $?p^2 = .351$], but no differences between younger and older adults. Further, the three groups did not differ in overall hit rate. The findings support protected encoding of within-domain associa-

tions and challenge boundaries of associative deficit hypotheses with more ecologically valid stimuli.

LONG-TERM MEMORY: Episodic

D58

AGE-RELATED DIFFERENCES IN PREFRONTAL AND MEDIAL TEMPORAL ACTIVATIONS DURING SUCCESSFUL RETRIEVAL Takashi Tsukiura[1], Yayoi Shigemune[1], Rui Nouchi[2], Toshimune Kambara[2], Ryuta Kawashima[2]; [1]Kyoto University, Japan, [2]Tohoku University, Japan — Although previous studies have demonstrated activations in the lateral prefrontal cortex (lPFC) and hippocampus during the recollection process, little is known about the aging effects on these activations. This fMRI study investigated the effects of aging on neural activations in these regions during the successful recollection of faces. During encoding, young and older female adults were presented with male faces one by one, and rated the goodness of impression for each face. During retrieval, the participants were presented with old and new faces, and recognized whether the faces were previously learned or not. Successful recognition activity for old faces (SRA-O) or for new faces (SRA-N) was identified by comparing activities between high- and low-confidence successful recognition for old and new faces, and the SRA-O and SRA-N contrasts were compared between young and older adults. The study yielded three main findings. First, SRA-O in lPFC and the hippocampus was greater for young than for older adults, whereas the parahippocampal gyrus showed greater SRA-O in older adults than in young adults. Second, SRA-N in lPFC and the hippocampus was greater for young than older adults, but greater SRA-N for older adults was not identified in any region. Third, correlations between lPFC and hippocampal activities were significantly higher in young adults than in older adults. Taken together, age-related decline in the recollection process of memory for faces could be modulated by interactions between lPFC, which is associated with the strategic process, and the hippocampus, which is associated with the retrieval of memory details.

D59

FUNCTIONAL-ANATOMIC CORRELATES OF TEST-POTENTIATED LEARNING Steven M. Nelson[1], Kathleen M. Arnold[1], Laura M. Najjar[1], Adrian W. Gilmore[1], Bridgid Finn[1], Kathleen B. McDermott[1]; [1]Washington University in St. Louis — A growing body of literature suggests that retrieval practice can enhance long-term retention (for a recent review, see Roediger & Butler, 2011). In addition, retrieving has also been shown to have indirect benefits such that the act of taking a test has ramifications for how an individual studies or continues to learn post-test. The finding that testing can indirectly benefit subsequent study is referred to as test-potentiated learning (Izawa, 1971). The current experiment sought to better understand the functional-anatomic correlates of test-potentiated learning using functional MRI. Subjects initially studied paired-associates, and then either were given a test or restudy opportunity. Additionally, some of the items were not presented during this portion of the experiment. Subjects then simply restudied all of the items in a final phase. This manipulation determined whether neural activity in the final study phase was differently modulated as a result of taking a test as opposed to re-exposure. Regions located in parietal cortex were among the most robust when contrasting items that were tested vs. restudied. Though many regions were modulated based on successful recall, when constraining our search to regions that showed greater activity for all tested items, a region in posterior inferior parietal lobule (pIPL) emerged. This region has been implicated in studies of recognition memory as supporting processes related to perceived oldness and reliably shows old > new effects (Nelson et al., 2010). Thus, testing items may increase the potency of this signal, which may play a role in supporting long-term retention.

D60

NEUROPHYSIOLOGICAL EVIDENCE THAT MILD HYPOXIA PATIENTS HAVE SELECTIVE RECOLLECTION IMPAIRMENTS BUT INTACT FAMILIARITY Rick Addante[1,2], Charan Ranganath[1], John Olichney[1], Andrew Yonelinas[1]; [1]University of California - Davis, [2]University of Texas - Dallas — In several previous behavioral studies we have identified a group of amnestic patients that exhibit selective deficits in recollection with preserved familiarity-based recognition, but other behavioral studies have suggested that this type of patient might exhibit deficits in both recollection and familiarity. To examine recollection and familiarity processes in these patients, we recorded ERPs in three amnestic patients and six age matched controls while they made item recognition and source recognition judgments. ERP studies of recognition in healthy subjects have indicated that recollection and familiarity are related to a late positive component (LPC) and an earlier frontal component (FN400), respectively. The current patients were able to discriminate between old and new items, but were not significantly above chance at making source judgments. Moreover, whereas control subjects exhibited ERPs indicative of both recollection and familiarity, the patients only exhibited evidence of a familiarity correlate. In high confidence recognition responses, there was no evidence of recollection-related ERPs (i.e.: LPC), and this was qualified by a significant interaction of confidence (high vs. low recognition confidence) and group (patient vs. controls). The results verify that the patients do in fact exhibit a selective deficit in recollection, and have broad implications for understanding the cognitive neuroscience of episodic memory.

D61

DECLARATIVE (AWARE) MEMORY DETERMINES DIFFERENTIAL EYE MOVEMENTS FOR OLD AND NEW SCENES, EVEN WHEN THERE IS NO EXPECTATION OF MEMORY TESTING Christine N Smith[1], Larry R Squire[1,2]; [1]UCSD, [2]Veterans Affairs Medical Center, San Diego — Measures of eye movements indicate that individuals view old and new scenes differently depending on whether the scenes are old (repeated) or new (i.e., the repetition effect). This effect depends on hippocampus-dependent, declarative memory when participants know that memory is being tested. We explored the nature of this effect during free viewing when memory is irrelevant. In Experiment 1, participants viewed old and new scenes before they knew that memory would be tested. Memory was then tested independently with a subset of the scenes. Different list lengths and study times yielded three groups that differed in memory strength: Strong Memory (91% correct, N=20), Moderate Memory (73% correct, N=23), and Weak Memory (60% correct; N=23). The repetition effect was observed only in the Strong Memory condition. In Experiment 2, patients with bilateral lesions of the medial temporal lobe were impaired at remembering scenes in the Strong Memory condition of Experiment 1. In Experiment 3 (N=50), participants viewed 20 old and 20 new scenes without knowledge of a memory test. Then they viewed the old and new scenes a second time, making old/new recognition memory judgments and confidence judgments (1-6 scale; 1=Definitely New, 6=Definitely Old). The repetition effect during free viewing was observed only when recognition memory judgments were correct and/or when they were accompanied by high confidence. Thus, differential viewing of old and new scenes during free viewing reflects declarative memory. The repetition effect does not reflect an automatic or unconscious effect of recent experience.

D62

MEDIAL TEMPORAL LOBE DAMAGE AND ASSOCIATIVE REINSTATEMENT Melanie Cohn[1,2], MaryPat McAndrews[1,2]; [1]1Krembil Neuroscience Centre & Toronto Western Research Institute, [2]Department of Psychology, University of Toronto — Associative memory relies on the integrity of the medial temporal lobes (MTL). We have previously demonstrated that associative reinstatement (i.e., gain in item recognition when test items are presented in their studied pairings) is reduced in individuals with unilateral temporal excisions that include the hippocampus, surrounding cortices and temporal neocortex. Our goals were to determine

whether associative reinstatement is modulated by the degree of damage to left temporal regions and whether similar effects are found using within-domain associations (word-word) and between-domain associations (word-face). These two types of associations have been proposed to rely on perirhinal and hippocampal regions, respectively. We recruited individuals with left temporal excision and with temporal lobe epilepsy (TLE) who have less extensive MTL damage (usually more prominent in the hippocampus) as well as healthy controls. They studied word-word and word-face pairs. At test, they were presented with new-new, new-old, rearranged and intact pairings and indicated, using a 6-point confidence rating scale, whether the first word of the pair was studied before. Associative reinstatement scores were derived by subtracting the hit rate to rearranged pairs from that of intact pairs for both tasks. The reinstatement gain was significantly greater for word-word relative to word-face associations in controls and TLE, and reinstatement effects for both types were reduced solely in the excision group. Our findings highlight the critical dependence of reinstatement on MTL regions (possibly perirhinal cortex or peririnal-hippocampal interactions). The magnitude difference across association types may represent greater unitization of within-domain associations relative to between-domains ones.

D63

PROGRESSIVE LOSS OF WHITE MATTER IN FORNIX FROM 5 TO 32 MONTHS AFTER MODERATE TO SEVERE TBI AND ITS DELETERIOUS EFFECT ON MEMORY Areeba Adnan[1], Morris Moscovitch[2], Adrian Crawley[3], David Mikulis[3], Brenda Collela[1], Robin Green[1]; [1]Toronto Rehabilitation Institute, [2]University of Toronto, [3]Toronto Western Hospital — Objectives: (1) To examine, using diffusion tensor imaging (DTI), whether fornix damage after moderate to severe traumatic brain injury (TBI) continues to progress sub-acutely; and, (2) To measure the relationship between structural changes in the fornix and recovery of memory function. Methods: 19 patients with moderate to severe TBI were assessed using DTI and neuropsychological assessments at 5 and 32 months post injury. Neuropsychological measures included Wechsler Memory Scale Logical Memory test (WMS-LM), Rey Auditory Verbal Learning Test (RAVLT) and Rey Visual Design Learning Test (RVDLT). Control variables included the symbol digit modalities test oral (SDMT-O) and Acute Care Length of Stay (ACLOS). DTI measures included fractional anisotropy (FA) values for the column/body, right crux and left crux of the fornix Results : Paired t-tests showed significant FA reductions from 5 months to 32 months for the column/body (t= 4.259, P<0.05, Cohen's d= 0.60), right crux (t=4.098, P<0.05, Cohen's d= 0.69) and left crux of fornix (t=3.197, P<0.05, Cohen's d= 0.56). After controlling for SDMT-O and ACLOS, change in logical memory was found to be correlated with change in FA of the right crux (Pearson r= 0.707, P<0.05) and the left crux of the fornix (Pearson r= 0.635, P<0.05). Conclusions : There is a loss in fornix integrity within the sub-acute stages of TBI, and greater FA reductions in the right and left crux of the fornix are associated with poorer verbal memory recovery. Such changes within white matter tracts may explain the poor cognitive recovery observed in TBI patients.

D64

REORGANISATION OF MEMORY LOAD IN TEMPORAL ASSOCIATION TRACTS IN MILD COGNITIVE IMPAIRMENT Claudia Metzler-Baddeley[1], Sarah Hunt[2], Derek K Jones[1], John Aggleton[1], Anthony Bayer[3], Michael J. O'Sullivan[1,4]; [1]Cardiff University Brain Research Institute (CUBRIC), School of Psychology and Neuroscience and Mental Health Research Institute, Cardiff University, [2]NISCHR CRC, South East Wales Research Network, Cardiff, [3]Cardiff Memory Team, Llandough Hospital, LLandough, Cardiff, [4]Department of Clinical Neuroscience, Institute of Psychiatry, King's College , London — Episodic memory is supported by networks of white matter tracts that connect temporal with frontal and parietal regions. Degradation of white matter is increasingly recognised as important feature of memory changes associated with Mild Cognitive Impairment (MCI) but the precise significance of the specific connections within these networks remains to be characterised. Furthermore, recent evidence from fMRI studies in MCI suggest that the brain may respond to disease by reorganising the structure and the connections of its memory networks. The present study employed diffusion-weighted MRI tractography to reconstruct three temporal fasciculi presumed to link components of memory networks - the fornix, the parahippocampal cingulum, and the uncinate fasciculus. A group of 25 MCI patients was compared with 20 healthy controls matched for age, education, and sex. Patients and controls differed significantly in all measures of episodic memory except for familiarity based memory. For the controls, episodic memory was only associated with changes in fornix microstructure and not with changes in the other tracts. In contrast, for MCI patients, memory was associated with the status of the parahippocampal cingulum and the uncinate fasciculus, but not of the fornix. Moreover, familiarity based memory was specifically associated with variation in parahippocampal cingulum microstructure. This pattern of dissociations suggests that in the healthy brain the fornix bares most of the episodic memory load whereas in the presence of a compromised mediotemporal lobe system, other temporal association tracts may be recruited to support familiarity based memory function and to compensate for fornix loss.

D65

EFFECTS OF SLEEP ON MEMORY AND REACTIVITY FOR POSITIVE EMOTIONAL PICTURES rebecca spencer[1], Syndey Adams[1], Bengi Baran[1]; [1]University of Massachusetts, Amherst — Recently we illustrated that negative emotional memories are consolidated over sleep and this is accompanied by preserved emotional reactivity relative to the attenuated emotional response and reduced memory accuracy observed following wake. In the present study, we investigated processing of positive emotional stimuli over sleep. Seventy young adults (aged 18-30) were tested over two sessions separated by 12-hrs with overnight sleep (Sleep group) or daytime wake (Wake group). In both sessions, participants provided valence and arousal ratings for IAPS images selected to represent neutral to positive valence. Sleep enhanced memory for positive images ($F(1,68)=3.76$, $p=.057$) but no such benefit was observed for the interleaved neutral images ($F(1,68)=.27$, $p=.61$). Emotional reactivity to positive images was attenuated (towards neutral) over both the sleep and wake intervals but the magnitude of attenuation tended to be higher in the Sleep group ($F(1,68)=3.09$, $p=.08$). Initial emotionality ratings were similar across groups, excluding possible circadian effects on performance (all $p>.65$). There was no significant relationship between memory accuracy and change in emotional reactivity suggesting these two processes may occur independently ($r=.08$, $p=.7$). These results suggest that sleep may prioritize consolidation of positive memories over neutral memories presented in the same context. Moreover, the subjective reactivity to emotionally positive stimuli is attenuated by sleep, in contrast to the protection of the emotional reaction to negative items following sleep. Collectively, this may reflect an adaptive function of sleep in maintaining the responsiveness and memory for threatening stimuli and decreasing the response to items that are not threatening.

D66

IMPLICIT MEMORY PROVIDES PERCEPTUAL AND CONCEPTUAL INFORMATION FOR EXPLICIT RECOGNITION DECISIONS Philip Ko[1], Bryant Duda[1], Erin Hussey[1], Brandon Ally[1]; [1]Vanderbilt University — Recent evidence suggests that perceptual implicit memory informs explicit recognition decisions. We hypothesized that recognition mediated by implicit memory, or implicit recognition, could also be based on conceptual information. To examine this hypothesis, participants studied pictures of real-world objects. At test, they viewed studied items, unstudied items, and exemplars drawn from the same basic-level categories as the studied items, under very difficult viewing conditions. For each item, participants reported whether they could identify the item, and then made an old/new judgment regardless of whether the item could be identified. Event-related potentials (ERPs) were recorded during test. Recognition behavior on trials when the items could not be identified showed a greater number of studied items rated as "old" compared to the exemplar and unstudied items, confirming perceptually-based

implicit recognition. Importantly, a greater number of exemplar items were rated as "old" compared unstudied items, indicating a significant conceptual contribution to implicit recognition. The ERP results revealed classic old/new effects in frontal and parietal regions associated with explicit recognition for the identified items. In contrast, ERPs for unidentified items showed reverse old/new effects over occipital regions. Similar to previous work, topographic differences between studied and exemplar items revealed a neural correlate associated with perceptual implicit recognition. Supporting our behavioral results, topographic differences between exemplar and unstudied items demonstrated distinct activity for conceptual implicit recognition. Together, these behavioral and ERP results confirmed previous findings of perceptual implicit recognition, but also revealed novel findings indicating that conceptual information makes an important contribution to implicit recognition.

LONG-TERM MEMORY: Semantic

D68

ELECTROPHYSIOLOGY OF NAMING BASED ON ODORS VERSUS VISUAL OBJECTS Robert Hurley[1], Marsel Mesulam[1], Jay Gottfried[1], Jonas Olofsson[2]; [1]Northwestern University, [2]Stockholm University — Healthy adults are able to name visual objects both quickly and effortlessly, reflecting close cooperation between the ventral visual stream and the left perisylvian language network. Odor naming depends on interactions with the medial frontotemporal olfactory network, and is subjectively more difficult and objectively less accurate compared to picture naming. The basis for this discrepancy is currently unknown. We used the event-related potential (ERP) method to explore the semantic integration of visual and odor objects with word labels. We hypothesized that odor-based mapping to words would be distorted relative to visual-based mapping, and that this distortion would extend beyond perceptual identification to a deeper stage of semantic association. Fifteen younger adults were presented with a set of 12 objects from 3 edible and 3 inedible categories. Participants rated pictures of each object as being more familiar than odors, consistent with a general lack of expertise for odors. Participants were then presented with odor or picture object primes followed 2 seconds later by matching, related (from the same category), or unrelated word probes. Accuracy was lower on matching and related odor trials, suggesting difficulty in assigning labels to similar odors from the same category. We used the event-related potential (ERP) technique to evaluate the quality of lexical mapping on the remaining trials where participants responded correctly. N400 potentials were more spatially focal and of higher amplitude on odor trials compared to picture trials, providing evidence of qualitative differences in the lexical mapping from each object modality.

D69

OBSERVED MANIPULATION INDUCES OBJECT REPRESENTATIONS IN FRONTO-PARIETAL CORTEX Naima Rüther[1], Marco Tettamanti[2], Stefano Cappa[3], Christian Bellebaum[1]; [1]Ruhr University Bochum, Germany, [2]San Raffaele Scientific Institute, Italy, [3]Vita-Salute San Raffaele University, Italy — The factors determining semantic memory organization are still a matter of debate. Modality-specific theories propose that neural object representations depend on the modalities of object-related experience. For tools, representations in fronto-parietal cortex would thus be caused by the involvement of these brain regions during tool manipulation. The aim of the present study was to elucidate if mere observation of tool manipulation can induce object representations in fronto-parietal brain regions. Thirty-six novel, manipulable, tool-like objects were created, each serving a particular function. Seventeen participants received object-related training in three sessions. One set of 12 objects was manipulated by the experimenter during training, and the subjects observed the manipulation (observed manipulation objects, oMO). Another set of 12 objects was visually explored by the participants (visually trained objects, VTO), and the third set of objects was not part of the training (not trained objects, NTO). Pre- and post-training, subjects' brain activity was assessed using functional magnetic resonance imaging while they completed a matching task with images of the objects. After training, oMO elicited stronger activity than NTO in the left inferior parietal lobule and inferior frontal gyrus including Brodmann Area (BA) 45. In the same inferior frontal region activity was also higher for oMO than VTO, whereas for VTO vs. NTO higher activity was found in a more anterior part of the inferior frontal gyrus (BA 10). The observation of tool manipulation is thus capable of inducing object representations in fronto-parietal brain regions, which are typically associated with knowledge about active tool use.

D70

MAPPING THE SIMILARITY SPACE OF CONCEPTS IN SENSORIMOTOR CORTEX Elizabeth Musz[1], Eiling Yee[1,2], Sharon L. Thompson-Schill[1]; [1]Department of Psychology, University of Pennsylvania, [2]Basque Center on Congition, Brain and Language — How is conceptual information represented across sensory and motor cortex? Rather than merely demonstrating that retrieving a feature of an object, such as its shape, activates a relevant sensorimotor region, such as occipitotemporal cortex, we tested a stronger prediction of sensorimotor theories of concepts, namely that the similarity of the neural representations of two concepts in a given region should reflect their similarity on a specific dimension. We measured the magnitude of fMRI-adaptation (our index of neural similarity) to word pairs that varied according to their similarity on shape (bagel-tire) and manipulation (key-screwdriver). Degree of shape similarity was positively correlated with the magnitude of fMRI-adaptation in two regions involved in visual object recognition (left lingual and fusiform gyri), whereas degree of manipulation similarity was positively correlated with adaptation in two regions involved in planning and performing object-related actions (left inferior parietal and precentral gyri). That is, we identified two distinct neural similarity spaces that map onto conceptual similarity in different ways, and these effects confirm the predictions from sensorimotor theories. Surprisingly, we also observed inverse-adaptation (i.e., more activation) in the same regions: In visual regions, greater manipulation similarity led to inverse adaptation; and in action regions, greater shape similarity led to inverse adaptation. We will discuss the possibility that these inverse-adaptation effects reveal interactions between conceptual representations, and that these interactions serve to magnify differences in the distinctive features of related concepts. These findings illustrate the importance of examining neural similarity for our understanding of conceptual representation.

D71

IMPAIRED BINDING OF PERCEPTUAL INFORMATION WITHIN SEMANTIC MEMORY IN EARLY-STAGE ALZHEIMER'S DISEASE: BEHAVIORAL EVIDENCE FOR DISRUPTED FUNCTIONAL CONNECTIVITY Elena Festa[1], Brian Ott[1,2], Geoffrey Tremont[1,2], William Heindel[1]; [1]Brown University, [2]Rhode Island Hospital — Previous studies have demonstrated impaired sensory binding associated with corticortical disconnectivity in Alzheimer's disease (AD). Disrupted functional connectivity has also been observed in resting-state networks of AD patients and patients with mild cognitive impairment (MCI). Because real objects (particularly living items) are represented as integrated sets of perceptual features distributed across distinct cortical areas, the semantic memory impairments observed in AD may be attributable to the disruption of functional connectivity within these cortical areas. To examine this issue, healthy controls and AD/MCI patients were given a Stroop-like task in which they named the color of pictures of real world living and nonliving objects as quickly as possible. Objects with strongly associated colors were presented in either typical (red strawberry) or atypical (yellow strawberry) colors; objects without strongly associated colors served as neutral stimuli. While both groups showed reduced accuracy for the typical and atypical stimuli compared to the neutral stimuli, the patient group showed an additional reduction in accuracy for the typical living (but not nonliving) stimuli. The patient group also displayed an additional increase in color naming latency for the typical living stimuli. Results suggest that binding of distributed object featural representations is disrupted at the earliest stages

of AD, such that access to color features is more difficult for living objects. These findings not only provide further confirmation of a featural binding deficit associated with the neocortical disconnectivity in AD, but also provide support for a fundamental distinction between the stored representations of living and nonliving objects.

D72

I KNOW I'VE SEEN YOU BEFORE: EXAMINING THE BRAIN BASES OF EPISODIC AND SEMANTIC MEMORY RETRIEVAL USING RECOLLECTION AND FAMILIARITY Sarah I. Gimbel[1], James B. Brewer[2], Anat Maril[1]; [1]The Hebrew University in Jerusalem, [2]University of California, San Diego — Episodic and semantic memory retrieval have been well studied, yet only episodic memory has been subdivided into judgments of recollection/familiarity. To disambiguate results of studies comparing episodic and semantic memory, we seek to study judgments of episodic and semantic item-only memory, free from additional information inherent in unconstrained studied of memory retrieval. We first behaviorally show that subjects can divide semantic memories into recollection/familiarity using a new set of stimuli, and that additional information retrieved during semantic recollection is itself semantic in nature. Using fMRI, we then examine the differences in BOLD activity during judgments of episodic and semantic recollection/familiarity. No differences were found in cortex or in medial temporal lobe when subjects made episodic and semantic recollection judgments. However, judgments of episodic and semantic familiarity showed different networks of activation in cortex and medial temporal lobe. Using the medial temporal lobe clusters as seed regions, functional connectivity during episodic and semantic familiarity differed. While there was no difference in activation when additional information was retrieved along with the item, without access to the context necessary for memories to be recollected, episodic and semantic memory retrieval functionally differentiate in cortex, substructures of the medial temporal lobe, and functional correlation of cortex with these medial temporal lobe structures. This could be a result of differences in the presence and accessibility of episodic and semantic additional information; episodic items have no schema while semantic items must have some schema in order to be identified as familiar, even if that information is inaccessible.

D73

YOU JUMP, I JUMP: NEURAL SENSITIVITY TO ABSTRACT ACTION SEMANTICS Christine Watson[1], Eileen Cardillo[1], Bianca Bromberger[1], Anjan Chatterjee[1]; [1]University of Pennsylvania — We used perceptually-rich photographs of human actions and pared-down drawings of actions to test the hypothesis that concrete versus more symbolic formats recruit different representations in the brain. We also tested if activity in sensorimotor cortices responds to the abstract identity of an action across multiple instances of that action, irrespective of format. Using repetition suppression functional magnetic resonance imaging, we asked participants to decide if pairs of photographs and drawings referred to the same or different actions. Items in a pair depicted identical instances of an action (SAME), different instances of the same action (ALT), or different actions altogether (DIFF). We predicted decreased neural activity for SAME relative to DIFF trials in perceptual areas and for ALT relative to DIFF trials in areas coding abstract action identity. In visual motion area MT, we observed significant suppression for SAME but not ALT trials relative to DIFF trials. In motor cortex, we observed significant suppression for both SAME and ALT trials relative to DIFF trials. These results suggest that area MT does not represent abstract action identity but that different instances of an action may elicit the same embodied motor response. We also hypothesized that schematic drawings would activate areas different from, and possibly adjacent to, sensorimotor areas activated by photographs. Partially consistent with this hypothesis, preliminary whole-brain analyses comparing photographs and drawings indicated photographs more strongly activated bilateral occipital poles. Drawings more strongly activated right superior parietal cortex, an area associated with impaired understanding of schematic spatial relations when damaged.

D74

FEATURE DIAGNOSTICITY AFFECTS SEMANTIC REPRESENTATIONS OF NOVEL AND COMMON OBJECT CATEGORIES Nina S. Hsu[1], Margaret L. Schlichting[2], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania, [2]University of Texas at Austin — A central principle in sensorimotor theories of concepts is that categories may differentially rely on some sensorimotor regions over others due to each category's properties. While there is evidence for basic predictions of sensorimotor theories, less research exists about the principles leading to different representations across categories. In two experiments, we explored how feature diagnosticity affected neural conceptual representations by examining how variation in diagnosticity of color information affected recruitment of color-sensitive visual areas during conceptual retrieval. In Experiment 1, subjects were trained to learn that color and shape were necessary features in novel object representations (similar to limes and lemons), or that shape alone was a sufficient feature in novel object representations (similar to stop signs and yield signs, where color is available but not necessary). In Experiment 2, subjects were asked about categories wherein color is necessary (fruits and vegetables) or not (household items). For both experiments, subjects completed a feature listing task describing the objects, then performed a shape knowledge retrieval task while undergoing fMRI. In visual areas involved in color perception, we found greater activity during the shape retrieval task for color+shape subjects than for shape subjects. We also found greater activity in these areas during the task for fruits and vegetables compared to household items. In both experiments, prioritizing color in the feature listing task correlated with brain activity in color-sensitive regions during the task. These results suggest neural correlates for diagnostic features, and that when activating object representations, diagnostic features may be retrieved automatically.

D75

ORDINAL AND CARDINAL PROCESSING OF SYMBOLIC AND NON-SYMBOLIC NUMBERS Ian Lyons[1], Sian Beilock[1]; [1]University of Chicago — We investigated neural areas involved in processing ordinal versus cardinal information in symbolic (Arabic numerals) and non-symbolic (dot-arrays) numerical stimuli. Behavioral results showed worse performance with larger numerical distances for both ordinal and cardinal judgments using non-symbolic stimuli. For symbolic stimuli, this effect was reversed distance effect on ordinal but not cardinal judgments. Symbolic ordinal judgments showed greater activation than both symbolic cardinal and non-symbolic ordinal judgments in left posterior supramarginal gyrus (SMGp), and left dorsal and ventral premotor cortex (PMd, PMv). Contrasting symbolic ordinal with symbolic cardinal judgments showed greater activity for the former in left PMd, and the opposite pattern in right SMGp and angular gyrus (AG). Accessing ordinal information in numerical symbols appears to operate via a left-lateralized combination of procedural and retrieval processes; accessing cardinal information in numerical symbols may rely more on a bilateral retrieval process. Non-symbolic ordinal judgments showed greater activity than both non-symbolic cardinal and symbolic ordinal judgments in right dorso-lateral prefrontal cortex (DLPFC) and right IPS. Contrasting non-symbolic ordinal and non-symbolic cardinal judgments revealed greater activity for the former in right IPS and right DLPFC. Accessing ordinal information in non-symbolic numerical stimuli appears to operate by iteratively comparing items in regions known to support cardinal representation of approximate, analogue magnitudes. Symbolic and non-symbolic representation of numbers may be less similar than previously assumed. Ordinal processing in particular appears to operate in a fundamentally different manner for numerical symbols. We propose that symbolic numbers form a complex associative network; non-symbolic numbers do not.

D76

CATEGORY LEARNING IN ALZHEIMER'S DISEASE DEPENDS ON THE MODE OF ACQUISITION: EVIDENCE FOR MULTIPLE CATEGORIZATION SYSTEMS William Heindel[1], Elena Festa[1], Kelly Landy[2], David Salmon[2]; [1]Brown University, [2]University of California, San Diego — Recent studies suggest that category learning may involve multiple, qualitatively distinct memory systems, with the relative involvement of each system depending at least in part upon the mode of knowledge acquisition: a) Observational (e.g., paired-associate) learning may primarily engage an explicit episodic/semantic system mediated by the medial temporal lobe; b) Trial-by-trial feedback learning may primarily engage a procedural system mediated by the basal ganglia; and c) Incidental learning may primarily engage the perceptual representation system mediated by sensory cortices. The degree to which patients with Alzheimer's disease (AD) demonstrate impaired or intact ability to acquire new categorical information may therefore critically depend upon the mode of acquisition. To examine this issue, groups of healthy controls and AD patients were administered three category learning tasks that used the same stimuli but that differed in mode of acquisition. Subjects were trained on low-distortion exemplars of novel cartoon animal categories, and then tested on different low-distortion exemplars, high-distortion exemplars, and prototypes of each category. Despite impaired explicit recall of category features in all three tasks, patients showed differential patterns of category acquisition across tasks: a) Under feedback conditions, patients showed intact acquisition of both exemplar and prototype information; b) Under observational conditions, patients showed intact prototype but impaired exemplar acquisition; and c) Under incidental conditions, patients showed greatest impairment on prototype acquisition. Taken together, these results support the role of multiple memory systems underlying category learning, and suggest that multiple processes may contribute to the semantic memory deficits observed in AD.

D77

POSSIBLE CEREBELLAR CONTRIBUTIONS TO SEMANTIC FLUENCY Jerillyn Kent[1], Sean C. Matthews[1], Michael N. Jones[1], Amanda R. Bolbecker[1,2,3], Olga Rass[1], Brian F. O'Donnell[1,2,3], William P. Hetrick[1,2,3]; [1]Indiana University Bloomington, [2]Indiana University School of Medicine, [3]Laure D. Carter Memorial Hospital — Interest in the cerebellum's contribution to cognition has increased in recent years. Theoretical models of psychopathology identify the cerebellum as a critical node in a coordinative network regulating cognition and motor function. We hypothesized that performance on delay eyeblink conditioning (EBC), a cerebellar-dependent associative learning task, would be correlated with semantic fluency performance in healthy individuals (n=10) but not in schizophrenic (n=8) and bipolar (n=11) participants, both populations with documented cerebellar anomalies. Subjects completed EBC and a semantic fluency task. During EBC, an airpuff that elicits an unconditioned blink response is repeatedly paired with a tone. Subjects develop a conditioned blink response (CR) to the tone that precedes airpuff onset. In the semantic fluency task, subjects named exemplars from the "animal" category for one minute. In healthy participants, but neither patient group, the number of items generated on the semantic fluency task correlated with CR timing ($r(8)=-0.71$, $p=0.02$). A computational model of semantic memory was applied to the semantic fluency data to quantify the structure of the semantic space formed by each subjects' exemplars (i.e., how semantically related successively generated items were to each other). In controls, CR timing was also marginally significantly related to the semantic neighborhood density of exemplars produced (i.e., how many other exemplars exist in a given sub-category of animals) ($r(8)=-0.63$, $p=0.05$). This relationship between performances on a cerebellar-mediated task and semantic fluency in controls supports the hypothesis that the cerebellum is involved in the coordination of cognitive processes in individuals with intact cerebella.

D78

CATEGORY DISSOCIATIONS IN VENTRAL TEMPORAL CORTEX ARE ASSOCIATED WITH DIFFERENT PATTERNS OF INTRINSIC FUNCTIONAL CONNECTIVITY William Dale Stevens[1], Michael Henry Tessler[1], Kelly Anne Barnes[1], Alex Martin[1]; [1]National Institutes of Health — The topographical organization of category-specialized regions in human ventral temporal cortex is remarkably consistent across individuals. A well-documented example of this is the functional-anatomic dissociation between processing of animals and tools in lateral and medial regions of the fusiform gyrus, respectively. Although the determinants of this category-related brain organization are largely unknown, one recently suggested possibility is that it is driven, in part, by differential connectivity with other functionally relevant brain areas (Martin, 2006; Mahon & Caramazza, 2011). We hypothesized that the preferential involvement of medial fusiform cortex in the perceptual and conceptual processing of tools is associated with intrinsic functional connectivity (FC) of this region with other brain regions critical for processing their relevant properties. We used fMRI and a multi-category functional localizer to identify a tool-preferential region ("tool ROI") within the medial fusiform cortex of healthy young adults. We then used these tool ROIs as seeds in whole-brain FC analyses of independent rest-runs in these same participants. Across participants, the medial fusiform tool ROI showed strong intrinsic FC with other brain regions that are critical for processing different types of category-specific properties, including regions involved in: 1) perception of non-biological motion (posterior middle temporal gyrus); 2) storing and/or retrieving "motor programs" (ventral premotor cortex); and 3) visuo-motor transformations necessary for execution of complex hand gestures (inferior parietal lobe). These results are consistent with the idea that the topographical organization of category-specialized regions in ventral temporal cortex depends on connectivity with other domain relevant regions of the brain.

D79

RAPID HIPPOCAMPAL INDEPENDENCE IN THE DECLARATIVE MEMORY SYSTEM Steffen Gais[1], Melanie Graetsch[1], Carolina Roselli[1], Stefan Glasauer[1], Virginia Flanagin[1]; [1]LMU Munich — The hippocampus is thought to be the crucial structure for declarative memory. According to the current standard model, spatial information, object relations or episodic memories are believed to be stored in the hippocampus, at least for an extended period of time after initial acquisition. Recent evidence has questioned this view, suggesting faster consolidation or no consolidation at all for some forms of memory. The present study looked at brain activity during retrieval of different types of declarative material learned 30 min earlier. The material used were words associated to the previous word of the list (sequential), words associated to autobiographical events (episodic), or words linked to locations along a well-known path (spatial). Recall in all three conditions showed common activity in occipital-parietal areas, particularly the left precuneus. The spatial condition additionally employed the retrosplenial cortex and more lateral occipital areas. Only the episodic condition recruited a network comprising the lingual and fusiform gyri and the hippocampus. Posterior probabilities from a Bayesian analysis confirmed this distinction. These findings challenge the concept of independent slow and fast learning systems and demonstrate the possibility of rapid hippocampal independence in some forms of episodic memory.

D80

THREAT AS A FEATURE OF SEMANTIC AUDITORY MEMORY Neena Rao[1], Michael Motes[1,2], Cliff Calley[3], Gail Tillman[1], Michael Kraut[4], John Hart, Jr.[1,2]; [1]Center for BrainHealth University of Texas at Dallas, [2]University of Texas Southwestern Medical Center, [3]University of Texas San Antonio Medical Center, [4]John's Hopkins University — A wide range of visual and auditory stimuli in our environments are processed in our interactions based on our semantic knowledge of that item. While previous research has identified neural regions that preferentially activate to categories of visual stimuli (e.g., tools, faces, houses, etc.), little has been done for auditory

stimuli. The present study used fMRI to explore nonverbal and environmental auditory processing of varying categories and features. Stimuli were grouped in five different categories including (1) humans, (2) objects, (3) animals, and (4) weapons and musical instruments with two different features within each category including (1) threatening and (2) nonthreatening. Scrambled sounds of the stimuli were also used to control for perceptual processing. There were a total of 16 different stimulus types (e.g., human scrambled threatening, human scrambled nonthreatening, human real threatening, and human real nonthreatening). While undergoing fMRI scanning, twenty-one right-handed adults (Mean Age = 21.81, Male = 16) were to indicate if the sound was real or non-real with a button-press. Behavioral results revealed a main effect of category on accuracy and reaction time. Within bilateral superior temporal, right posterior cingulate, right medial frontal, left occipital, and left frontal there were significant category differences. Additionally, within these regions, there were multiple significant interactions between category and feature distinctions where threatening differed for nonthreatening sounds. These results suggest region-specific preferential activation to category and feature processing of auditory stimuli.

METHODS: Electrophysiology

D81

CLASSIFYING VISUAL PERCEPTION ON A TRIAL-BY-TRIAL BASIS USING EEG SIGNALS Monica Rosenberg[1], Alexandra List[2], Aleksandra Sherman[2], Marcia Grabowecky[2,3], Satoru Suzuki[2,3], Michael Esterman[1,4]; [1]Boston Attention and Learning Lab, VA Boston Healthcare System, [2]Department of Psychology, Northwestern University, [3]Interdepartmental Neuroscience Program, Northwestern University, [4]Boston University School of Medicine — We investigated the efficacy of multivariate pattern analysis (MVPA) for revealing EEG correlates of visual perception. EEG was recorded with 64 scalp electrodes from four participants as they passively viewed gray-scale stimuli varying along four dimensions: location (left or right visual field), category (face or Gabor), subcategory (male or female faces; high or low spatial frequency Gabors), and orientation (upright or inverted faces; horizontal or vertical Gabors). Group-averaged ERPs showed typical temporal shifts and amplitude differences for both contralateral-versus-ipsilateral stimuli and upright-versus-inverted faces. Using linear support vector machines, we performed MVPA on the same EEG data with approximately 1-ms precision to see if stimulus differences could be classified on a trial-by-trial basis. EEG signals occurring at specific time points (174 ms and 674 ms for left-versus-right classification, 180 ms and 271 ms for face-versus-Gabor classification, and 219 ms for upright-versus-inverted face classification) reliably predicted perceptual differences with accuracy ranging from 67% to 93%. Importantly, the critical time points were virtually identical for the four subjects. Although corresponding group-averaged ERPs differentiated a subset of these conditions, MVPA predicted stimuli on an individual subject level, provided remarkably consistent estimates of the timing of perceptually relevant neural information on a trial-by-trial basis, and revealed additional time windows of discrimination accuracy. Thus, MVPA offers a robust complementary approach to ERPs in using EEG data to uncover neural correlates of visual processing.

D82

DETECTION OF PATTERNS OF SPONTANEOUS NEURAL ACTIVITY USING ARTIFICIAL NEURAL NETWORKS Dillon Hambrook[1], Andrea Gomez-Palacio-Schjetnan[1], Matthew Tata[1], Artur Luczak[1]; [1]University of Lethbridge — Event-related designs are ubiquitous in cognitive neuroscience research, however real-world sensory input contains sequences of "events" that are far more complex and dynamic than the typical block of trials encountered in a neuroscience experiment. Event-related experimental designs require that we know, with high temporal fidelity, the exact moment at which a stimulus event might trigger mental activity of interest. This method is poor at making sense of activity that is not time-locked to such a discrete event. We present a method that uses a type of artificial neural network called a Self-Organizing Map (SOM or Kohonen network) to identify and sort stable, repeating patterns of activity in time series data. When applied to simulated intracranial electrophysiological (multi-neuronal spike trains) data in rats and simulated scalp-recorded electroencephalographic (EEG) data from humans, this method was able to reliably identify embedded patterns designed to model previously observed activity. In tests on real intracranial recording data from auditory cortex of rats, this method successfully identified patterns of activity associated with auditory stimulation without a priori knowledge of when that stimulation occurred in time. Applications to real scalp-recorded EEG data from humans are currently being tested and will be presented. Our method is flexible and could be adapted to a variety of time varying signals like BOLD-activation, ICA component activation, or time-frequency data from electrophysiological recordings to mine data for interesting, spontaneously occurring patterns of activity that may be missed by traditional analysis.

D83

PATTERN FORMATION AND NONLINEAR OSCILLATIONS IN A NEURAL POPULATION MODEL Lennaert van Veen[1], Kevin Green[1]; [1]University of Ontario Institute of Technology — One promising approach to the study of electrical signals in the cortex uses neural population models. Such models describe the dynamics of coarse-grained membrane potentials and synaptic activity. The membrane potential represented in the model is closely related to the measured electroencephalograph (EEG). One such model, formulated by Liley et al. (Network, Vol. 13, 2002, 67-113) has been particularly successful in reproducing alpha and gamma band activity, response to anaesthetic induction and other physiological effects. This model takes the form of a system of nonlinear, hyperbolic, partial differential equations. If we consider the input parameters of the model to be constant, we obtain a deterministic dynamical system that can be analysed with the tools of bifurcation analysis. This is a challenging task, owing to the large number of degrees of freedom in discretizations of the model over a cortical slab of several square centimetres with millimetre-scale resolution. For this reason, all bifurcation analysis published so far on this model has ignored spatial variability of the neural fields, thereby reducing the model to a small system of ordinary differential equations. On the other hand, the study of simpler population models has shown that these produce complicated patterns such as travelling waves and pulses (see, e.g., Coombes, Neuroimage, Vol. 52, 731-739). We will present the first results of a bifurcation study of the full-fledged, space and time dependent Liley model. In particular, we show that Hopf bifurcations change into Turing-Hopf bifurcations that spawn travelling waves and re-evaluate some earlier results.

D84

PROCEDURE FOR OVERCOMING TIME LOCKING VARIABILITY IN LOW-COST EEG SYSTEMS AND DEMONSTRATION ON A REALISTIC HEAD PHANTOM W. David Hairston[1], Solomon Diamond[2], David Kynor[3], Christopher Stachowiak[1]; [1]US Army Research Laboratory, Human Research and Engineering Directorate, Aberdeen Proving Ground, MD, [2]Thayer School of Engineering at Dartmouth, Hanover, NH, [3]Creare, Inc., Hanover, NH — Event-related ERP experiments require precise time locking between stimulus presentation times and the recorded EEG waveforms. While most contemporary EEG systems are precise in time-event recording, variability can still occur, especially with low-cost solutions, leading to degraded mean signal quality. One approach to overcome this problem is to utilize secondary logfiles; however, properly accounting for timing drift and variance errors remains difficult to implement. Here, we have developed a procedure for correcting timing drift and variance errors using an algorithm designed to be fairly universal. It works for several different types of current EEG systems and addresses most common limitations of secondary source data triggers arising from these systems (e.g. binary-only input, high-variance timing, drift, etc). To evaluate the procedure's efficacy, we performed tests on an anatomically accurate head "phantom", which generates realistic scalp potentials measurable with standard EEG

systems. Using phantoms is advantageous over other methods (e.g. using digitally simulated data which lacks realistic errors, or relying on averaged response from humans). The head phantom provides an accurately known "neurological" source signal in a reliable medium that can be measured by any EEG system in a realistic manner. It is conductively analogous to the human head, with multiple layers (brain, skull, scalp), embedded dipole electrodes, and programmable scalp potential dynamics. Using the phantom, we were able to verify the proposed trigger-correction algorithm to be not only correct for timing jitter and clock drift, but also provide highly-accurate timing with a relatively low-cost EEG system that might otherwise be unreliable.

METHODS: Neuroimaging

D85

AMYGDALA SUBNUCLEI-SEEDED FUNCTIONAL CONNECTIVITY: A NOVEL APPLICATION OF PROBABILISTIC TRACTOGRAPHY

Keith Yoder[1], Eric Porges[1], Jean Decety[1]; [1]University of Chicago — Functional magnetic resonance imaging cannot distinguish amongst various subnuclei of the amygdalae. However, a recent study provided a method for labeling nuclei within the amygdala utilizing combined structural MRI and diffusion tensor imaging (Saygin et al., Neuroimage 56, 2011). In the current study, a similar approach was used to identify amygdalar subnuclei in 50 healthy adult participants who underwent fMRI while viewing 10-second clips of either violent combat sports or a control condition (with similar visual content but no injuries or intent to injure). The functional scan was followed by a T1-weighted structural scan and a diffusion weighted scan. After correction for eddy currents, diffusion data were skull-stripped, tensors were fitted and primarily diffusion directions were calculated using Bayesian estimation. Next, a semi-automated segmentation routine was used to parcellate subjects' T1 images into cortical and subcortical regions. Probabilistic diffusion tractography was then conducted to calculate the likelihood of a connection between each amygdala voxel and 34 bilateral targets or the brainstem. The resulting probabilities were normalized, thresholded at 0.1, and binarized. Four Boolean statements were then used to classify amygdalar voxels as belonging to lateral, basal, central or medial subnuclei. These classification matrices were smoothed and those voxels that were contiguous with at least 6 classified voxels were included in a mask for that subnucleus. Masks identified through this method were used as seed regions for a functional connectivity analysis of the subjects' fMRI data allowing for a separation of functional connectivity between respective subnuclei.

D86

TASK-RELATED FUNCTIONAL CONNECTIVITY REVEALS MULTIPLE SCALES OF COGNITIVE PROCESSING

Jane Wang[1], Luis Amaral[1,2], James Booth[1]; [1]Northwestern University, [2]Howard Hughes Medical Institute — Functional connectivity (FC) has recently emerged as a promising new methodological tool for examining interactions between disparate brain areas. Combined with event-related functional magnetic resonance imaging (fMRI), which allows for experimental control over sources of inter- and intra-subject variability, FC can be used to assess the neural correlates of specific cognitive states. We conduct an fMRI connectivity analysis of 39 subjects (age 9 to 15) participating in a visually presented rhyming judgment task. We characterize links on three separate spatial scales: 1) within an anatomical region ("within"), 2) inter-regional within the same functional network ("between") and 3) inter-regional between functional networks ("cross"). Our two functional networks are derived from the group-level lexical minus null and the null minus lexical contrasts, resulting in 621 similarly sized regions of interest (ROIs) in total. Links are obtained by cross-correlating average time series from these ROIs after filtering at two frequency bands (0.008-0.1 Hz and 0.1-0.2 Hz) in order to assess the impact of frequency on network dynamics. Our results show that different brain activity patterns emerge as a function of task accuracy depending on the spatial and temporal scale. We report three key findings: 1) "between" links increase with accuracy, representing global integration, 2) nodes exhibiting "within" link increases with accuracy (local integration) are those found through graph theoretical measures to be highly central to the functional network, while noncentral nodes display local segregation, and 3) global integration is prominent at lower frequencies while local segregation is prominent at higher frequencies.

D87

PRELIMINARY EVIDENCE FOR OBESITY AND ELEVATIONS IN FASTING INSULIN MEDIATING ASSOCIATIONS BETWEEN CORTISOL AWAKENING RESPONSE AND HIPPOCAMPAL VOLUMES AND FRONTAL ATROPHY

Alexandra Ursache[1], William Wedin[1], Aziz Tirsi[1], Antonio Convit[1]; [1]New York University School of Medicine — Adolescents with type 2 diabetes mellitus (T2DM) exhibit deficits in memory and executive functioning, and hippocampal and frontal lobe reductions. In adults with T2DM, hippocampal reductions are associated with alterations in the cortisol awakening response (CAR) (an indicator of hypothalamic–pituitary–adrenal (HPA) axis integrity), but pathways between these abnormalities and diabetes associated factors are not well understood. Moreover, little is known about whether brain impairments and HPA axis abnormalities already exist in adolescents with pre-diabetic conditions such as obesity-associated insulin resistance (IR). Thus, this study first examined whether adolescents with IR exhibit alterations in the CAR, hippocampus, and frontal lobes and then examined pathways involving HPA axis dysregulation, brain abnormalities, and diabetes associated factors including Body Mass Index (BMI) and fasting insulin levels. We assessed 39 adolescents with IR and 20 demographically-matched lean adolescents without IR. Adolescents with IR had a blunted CAR, smaller hippocampal volume, and greater frontal lobe atrophy compared to controls, demonstrating that HPA axis disruptions may occur in subclinical forms of marked IR prior to development of the diabetic phenotype. Additionally, mediation analyses indicated that blunting of the CAR predicted higher BMI, which in turn predicted higher fasting insulin levels, which in turn predicted smaller hippocampal volumes and greater frontal lobe atrophy. While we cannot make causal claims, results suggest that HPA dysregulation is not only a result of brain abnormalities, but may also play a role in metabolic alterations that in turn may cause abnormalities in brain regions important for memory and executive functioning.

D88

ANALYSIS OF PHASE RELATIONSHIPS BETWEEN SINGLE-TRIAL NEURAL SIGNALS: TOWARDS A PHASE-BASED MAGNETOENCEPHALOGRAPHIC BRAIN-COMPUTER INTERFACE

Matthew Sacchet[1,2], Jürgen Mellinger[2], Karsten Rauss[2], Ranganatha Sitaram[2], Christoph Braun[3], Niels Birbaumer[2], Eberhard Fetz[4]; [1]Stanford Neurosciences PhD Program, Stanford School of Medicine, [2]Institute of Medical Psychology and Behavioral Neurobiology, University of Tübingen, Tübingen, Germany, [3]MEG-Center, University of Tübingen, Tübingen, Germany, [4]Department of Physiology and Biophysics, University of Washington — Phase relationships between signals from disparate brain regions have been observed in various attention paradigms. With the recognized importance of phase in cognitive neuroscience, it has become apparent that phase-based brain-computer interfaces (BCIs) may offer improved opportunities for cognitive training. We used two approaches to phase analysis: magnitude squared coherence (MSC, or coherence) and phase-locking value (PLV, or synchrony). We assessed single-trial phase in synthetic and real magnetoencephalograph (MEG) data. Single-trial variants of coherence (Welch's averaged, modified periodogram MSC estimation) and synchrony (single-trial PLV) were implemented. We explored three methods of creating test data: white noise generation, adding varying amounts of Gaussian noise to identical sine waves, and computing fast Fourier transforms (FFT) of real MEG data, adding circular noise to the sine (imaginary components), then computing inverse FFT to create phase-scrambled versions of the original data. The third method proved inferior because creating continuous data from IFFT data with introduced imaginary noise is difficult to implement without generating strong phase relationships in the data. The PLV

method of assessing single-trial phase in real MEG and synthetic data proved to be less effective because artificially high PLVs were found in white noise comparison datasets (used for statistical analysis). MSC estimates were optimized for data produced from both 10 and 40Hz sine waves. Future steps include automating optimization for smaller comparison intervals for window, overlap and data lengths, testing MSC and single-trial PLV against real MEG signals with known phase relationships, and developing better comparison datasets for single-trial PLV statistical assessment.

D89

EXAMINING CORTICAL FUNCTION AND CONNECTIVITY WITH CONCURRENT TMS AND EROS Nathan A Parks[1], Edward L Maclin[1], Kathy A Low[1], Diane M Beck[1,2], Monica Fabiani[1,2], Gabriele Gratton[1,2]; [1]Beckman Institute, University of Illinois Urbana-Champaign, [2]Department of Psychology, University of Illinois Urbana-Champaign — TMS is a powerful method for non-invasively disrupting cortical activity in the human brain. Concurrent TMS-neuroimaging approaches have demonstrated that TMS pulses not only activate directly stimulated tissue but also propagate trans-synaptically to interconnected brain regions, thus providing an effective tool for causally assessing connectivity within cortical networks. However, the integration of TMS with other neuroimaging technologies introduces major temporal or spatial limitations when imaging TMS-evoked responses. Here, we used a near-infrared optical imaging approach with high spatial and temporal resolution (the event-related optical signal, EROS) to record neuronal activation in response to a TMS pulse. In one experiment, we recorded EROS bilaterally from left and right motor strips during unilateral stimulation of the M1 hand representation. Ipsilateral activation of M1 was apparent within 16 ms of a TMS pulse and propagated to contralateral M1 within 48 ms. These results demonstrate that concurrent TMS-EROS can be used to measure cortical connectivity with unprecedented spatial and temporal precision. In a second experiment, we recorded EROS bilaterally from motor cortex while subjects performed a cued go/nogo task. Motor evoked potentials elicited by TMS were indicative of increased corticospinal excitation in the go condition and inhibition in the nogo condition. EROS activations were differentially affected by excitation and inhibition 100 ms prior to the average Go response time, indicating that EROS can differentiate between excitatory and inhibitory brain states. These results demonstrate that concurrent TMS-EROS is useful for measuring the dynamics of cortical connectivity and capable of examining novel questions about cortical function.

D90

MULTI-VOXEL PATTERN ANALYSIS OF NOUN AND VERB DIFFERENCES IN VENTRAL TEMPORAL CORTEX Christine Boylan[1], John Trueswell[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania — We tested the hypothesis that predictions about upcoming lexical-syntactic categories give rise to word form estimates in left ventral temporal cortex (VT). We conducted multi-voxel pattern analysis (MVPA) in VT when subjects were predicting, but crucially not viewing, nouns and verbs, thus removing any bottom-up information. We used the brain data to classify the prediction of nouns vs. verbs in both sentence and non-sentence contexts. In Experiment 1, subjects (n=10) viewed low semantic cloze probability sentences highly selective for either a noun or a verb completion; however, before the sentence-final word was shown, subjects searched a series of noisy images for a word to complete the sentence. In Experiment 2, subjects (n=4) were cued for single noun-typical nouns and verb-typical verbs for search in noise. Analyzing only those volumes collected when subjects predicted a word but saw pure noise, we trained and tested a simple neural network in a leave-one-out 4-fold cross-validation procedure. Mean classification performance of nouns vs. verbs in sentence contexts was significantly above chance (mean across subjects: 58%, chance = 50%). In the non-sentence word classifier (experiment 2), a given noun was more often confused with another noun than with a verb, and vice-versa. The sentence-context prediction results suggest that syntactic cues are sufficient to drive top-down predictions of word form features in VT. The within-category confusability of the individual word predictions (for which lexical-syntactic category was not necessary to predict the cued word form) suggests that retrieval of lexical-syntactic category may be automatic during word prediction.

D91

FRACTIONATING THE DEFAULT NETWORK IN YOUNGER AND OLDER ADULTS Karen Campbell[1,2], Omer Grigg[1,2], Cheryl Grady[1,2]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest, Toronto, ON — Recent work suggests that the default network (DN) consists of a core set of areas, including medial prefrontal cortex (PFC) and posterior cingulate cortex (PCC), and at least two subsystems that are brought online when needed. These include a medial temporal lobe (MTL) subsystem, active during remembering, and a dorsomedial PFC (dMPFC) subsystem, active during self-reflective thought. Further, the PCC itself can be subdivided into ventral (vPCC) and dorsal (dPCC) regions that are functionally connected with ventral DN regions and dorsal attention regions, respectively, depending on rest/task demands. The goal of this study was to use resting state functional connectivity (FC) to directly compare the networks involving these four regions and confirm that there are both common and unique aspects of FC, and to examine age differences in FC within each of these subsystems. Resting state fMRI data were collected from 31 younger and 24 older adults. Data were analyzed using a multivariate analysis technique which allows for the direct comparison of FC in multiple seeds (in this case, the MTL, dMPFC, vPCC, and dPCC taken from previous studies). We found that nodes within the DN show both a common network (resembling what is typically referred to as the DN), as well as distinct connectivity patterns with little overlap between them. Further, we found that older adults' FC patterns for each of these seeds resembled those of younger adults, but they showed weaker FC overall, suggesting age differences in both core and subsystems of the DN.

D92

NITRC: NEUROIMAGING INFORMATICS TOOLS AND RESOURCES CLEARINGHOUSE, A SUCCESSFUL KNOWLEDGE ENVIRONMENT FOR THE NEUROIMAGING RESEARCHER David Kennedy[1], Christian Haselgrove[1]; [1]University of Massachusetts Medical School — We report on a neuroimaging informatics knowledge environment recently expanded from MR to PET, EEG, MEG, SPECT, CT and optical neuroimaging tools and resources: Neuroimaging Informatics Tools and Resources Clearinghouse (NITRC). Funded by the NIH Blueprint for Neuroscience Research, NIBIB, NIDA, NIMH, and NINDS, NITRC fosters a user-friendly clearinghouse environment for the neuroimaging informatics community. NITRC's goal is to support researchers dedicated to enhancing, adopting, distributing, and contributing to the evolution of previously funded neuroimaging analysis tools and resources for broader community use. Located at www.nitrc.org, NITRC promotes software tools, workflows, resources, vocabularies, test data, and now, pre-processed, community-generated data sets (1000 Functional Connectomes, ADHD-200) through its Image Repository (NITRC-IR). NITRC gives researchers greater and more efficient access to the tools and resources they need; better categorizing and organizing existing tools and resources via a controlled vocabulary; facilitating interactions between researchers and developers through forums, direct email contact, ratings and reviews; and promoting better use through enhanced documentation. In Summary, NITRC facilitates access to a growing number of neuroimaging tools and resources (~450), and supports (~1 mil. hits monthly by ~142,750 unique visitors, initiating ~450,000 downloads). NITRC has established itself as a key resource for the advancement of neuroimaging research.

PERCEPTION & ACTION: Motor control

D93

DYNAMIC RECONFIGURATION OF HUMAN BRAIN NETWORKS DURING LEARNING Danielle Bassett[1], Nicholas Wymbs[2], Mason Porter[3,4], Peter Mucha[5,6], Jean Carlson[1], Scott Grafton[2]; [1]Complex Systems Group, Department of Physics, University of California, Santa Barbara, CA 93106, [2]Department of Psychology and UCSB Brain Imaging Center, University of California, Santa Barbara, CA 93106, [3]Oxford Centre for Industrial and Applied Mathematics, Mathematical Institute, University of Oxford, Oxford OX1 3LB, United Kingdom, [4]Complex Agent-Based Dynamic Networks Complexity Centre, University of Oxford, Oxford OX1 1HP, United Kingdom, [5]Carolina Center for Interdisciplinary Applied Mathematics, Department of Mathematics, University of North Carolina, Chapel Hill, NC 27599, [6]Institute for Advanced Materials, Nanoscience and Technology, University of North Carolina, Chapel Hill, NC 27599 — Learning is a complex phenomenon requiring flexibility of existing brain function and precision in selecting new functions to drive desired behavior. Selective adaptability is naturally provided by modular structure - system segregation into functional units - which plays a critical role in evolution, development, and function. From initial training through mastery of a simple motor skill, functional connectivity measurements of brain activity were acquired in an early learning study over the first 3 days of practice (N=18) and an extended learning study over the first 30 days of practice (N=20), where training exposure was manipulated in order to examine temporal scales of learning. We investigated the role of modularity in human learning by identifying dynamic changes spanning multiple temporal scales. In both early and extended learning, functional brain networks display modularity. During extended learning, modular organization is strongest for sequences that were practiced minimally (Repeated Measures ANOVA: $F(2,30)=12.48$, $p=0.0001$). During early learning, flexibility - which we measure by the allegiance of nodes to modules - in one experimental session predicts the relative amount of learning in a future session (Pearson correlation, $p<0.01$). Together, these two findings suggest that modularity and flexibility are adaptive network traits that correspond to the rapid performance improvement evident in early learning. Our work examines modular organization in early and extended learning, and provides a quantitative predictor of learning success. We develop and apply a dynamic network approach that is broadly applicable to disciplines where network adaptability is crucial to the understanding of system performance.

D94

MULTIVOXEL PATTERNS REVEAL FUNCTIONALLY DIFFERENTIATED NETWORKS UNDERLYING SPEECH MOTOR CONTROL Zane Zheng[1], Alejandro Vicente-Grabovetsky[2,5], Ewen MacDonald[1,3], Kevin Munhall[1], Rhodri Cusack[2,4], Ingrid Johnsrude[1,6]; [1]Queen's University, Canada, [2]Medical Research Council Cognition and Brain Sciences Unit, UK, [3]Technical University of Denmark, Denmark, [4]University of Western Ontario, Canada, [5]Donders Centre for Cognitive Neuroimaging, Netherlands, [6]Linkoping university, Sweden — Models of speech motor control posit an interactive, distributed network of brain regions supporting their function. An important component of such control is regulation of articulation when auditory feedback does not correspond to the intended motor gesture. However, previous neuroimaging studies have identified only a limited number of regions involved in this sensorimotor process. Here, by using functional magnetic resonance imaging (fMRI) and a multi-voxel pattern analysis (MVPA) framework, we have examined the functional organization underlying auditory feedback control, when altered and normal speech feedback are presented both as auditory concomitants of speaking and during listening. Right angular gyrus, right supplementary motor area, and bilateral cerebellum were observed to yield consistent neural coding patterns across altered feedback types, only during production but not during listening. These regions satisfy criteria for involvement in generation and processing of an error signal, an essential feature of speech motor control. A further assessment of the cortical networks exhibiting this interaction revealed additional fronto-temporal regions in which sensitivity to speech depends upon whether the participant is vocalizing or listening. Our results strongly support the view that functionally differentiable and distributed systems subserve auditory feedback processing, and provide a more comprehensive picture of the neuroanatomical substrates of speech motor control.

D95

THIS IS YOUR BRAIN ON POWER: ACTIVATING HIGH POWER DECREASES MOTOR RESONANCE DURING ACTION OBSERVATION Jeremy Hogeveen[1], Michael Inzlicht[3], Sukhvinder Obhi[1,2]; [1]Center for Cognitive Neuroscience, Wilfrid Laurier University, Canada, [2]Institute of Cognitive Neurocience, University College London, UK, [3]Department of Psychology, University of Toronto, Canada — Power refers to the ability to alter the state of another individual by providing rewards or punishments (Keltner et al., 2003). There is a tendency for those with power to pay less attention to the actions of their powerless counterparts (Fiske, 1993), which can be indexed by a decrease in the amount of nonconsious mimicry (NCM) they display during social interactions (Cheng & Chartrand, 2003). Here, we asked whether motor resonance (MR), or the mirroring of observed actions in the observers' motor system, is mediating the effect of power on NCM. Participants wrote a narrative documenting a vivid experience with, or without, power at the beginning of the experiment in order to prime high or low power, respectively (Galinsky et al., 2003). Then, using transcranial magnetic stimulation (TMS) induced motor-evoked potentials (MEPs), we examined the effect that the power prime had on subsequent MR during passive action observation. The low power group displayed a normative level of MR. In contrast, the high power group showed no MEP facilitation during action observation, suggesting that feelings of power modulate motor cortical output during action observation. Therefore, decreases in MR sensitivity when an individual has power could be the mechanism mediating power differentials in social attention and mimicry. Our results suggest that being in a position of power modulates the salience of others' actions to the observers' motor system. This has profound implications for the mechanisms underlying behavioural tendencies during temporary experiences with power, and the neurobiological differences underlying static power relationships.

D96

BMI-TELEOPERATION OF ANDROIDS CAN TRANSFER THE SENSE OF BODY OWNERSHIP Maryam Alimardani[1,2], Shuichi Nishio[2], Hiroshi Ishiguro[1,2]; [1]Graduate School of Engineering Science, Osaka University, [2]Advanced Telecommunications Research Institute International (ATR) — Teleoperators of an android robot occasionally experience an illusion of body ownership transfer as if robot's body has become part of their own body. This phenomenon resembles the "rubber hand illusion" in the absence of tactile feedback and is due to the movement synchronization between operators and robot. However, it was unknown whether this illusion can occur when operator's real motions are eliminated. Our research explores whether the mind control of an android's hands through a non-invasive BMI can induce the illusion of ownership toward the android's hands, in the absence of both tactile stimulation and proprioceptive feedback from subject's real hands. We hypothesize that the correlation of activities in the brain's motor cortex with visual feedback from robot's motions can affect operator's self-body perception. Nineteen trained participants wore an EEG electrode cap and performed motor imagery task while watching the android's hands through a head-mounted display. Brain signals were classified and translated into the robot's left or right hand motions. Participants experienced different sessions of operation and at the end of each session, robot's hand received an injection to measure participant's reaction to a pain-causing stimulus. Evaluation was made by questionnaires and skin conductance responses. Both measurement methods confirmed a body ownership transfer when the robot's hands moved exclusively in accordance with participant's intentions. Through this work we showed that the transfer of body ownership to

teleoperated androids is mainly due to the motion agency and can also occur in the absence of proprioceptive feedback from operator's muscle movements.

D97

ACTION UNDERSTANDING IS EXPERIENCE-INDEPENDENT IN INFANCY AND IS SHAPED BY EXPERIENCE WITH AGE Naznin Virji-Babul[1,2], Rose Ashley[1,2], Moiseeva Nadya[1,2]; [1]Dept. of Physical Therapy, University of British Columbia, [2]Child and Family Research Institute, Vancouver, B.C. — The human mirror neuron system is thought to be the underlying basis of perception-action coupling involved in action understanding. Numerous electrophysiological and brain imaging studies support the existence of a mirror neuron system in adults (Rizzolatti and Craighero, 2004; Iacoboni et al, 2005; Gallese et al, 2006; Virji-Babul et al, 2010), yet the question of the origins of the mirror neuron system and how this development is related to the infant's own abilities and experiences remains unclear. The aim of the present study was to characterize the pattern of mu rhythm modulation in infants and adults, for three types of actions: action that is developmentally within the motor repertoire of infants, action that is developmentally not within the motor repertoire of infants and object motion.Ten infants (4-11 months) and ten adults (20-30 years) participated in this experiment. Videos of 1.5 seconds duration depicting three different actions: human walking, hand reaching for an object and object motion (toy car, rolling ball), were prepared. EEG was recorded using high density HydroCel Geodesic Sensor Nets (EGI, Eugene, OR). We analyzed the mu rhythm activity for infants (6-9 Hz) and adults (8-13 Hz). Significant EEG desychronization over sensory-motor regions was observed under all conditions in young infants. In contrast, adults only showed significant mu desynchronization in response to human reaching and walking motions. These data suggest that infants may be predisposed early in life to understand coherent human and object action and that this basic perceptual mechanism is honed by sensorimotor experience.

D98

ACTION AND CONSCIOUSNESS: ENTRY INTO AWARENESS FROM BEHAVIORAL INCLINATIONS AND PERCEPTUAL MOTOR RESONANCE Shanna Cooper[1], Tara C. Dennehy[2], Ezequiel Morsella[1,3]; [1]San Francisco State University, [2]University of Massachusetts, Amherst, [3]University of California, San Francisco — While substantial research has examined how attentional and perceptual processes influence that which enters conscious awareness ('entry,' for short), little research has illuminated how action-related processes (e.g., activation of action plans) influence entry, even though neural evidence suggests that conscious awareness is intimately related to crosstalk between perception and action processing. In a series of experiments, we examined the influence of 'perceptual resonance' (Studies 1 and 2) and action-related tendencies (e.g., subjective urges and subjective effort; Study 3) on entry. Studies 1 (n = 19) and 2 (n = 33) reveal that actions (e.g., circular motions) that are isomorphic to a subliminally presented visual target (e.g., a circular object) may 'release' the target from masking under certain conditions, $t(32) = 1.775$, $p = .085$. This is explained as a case of 'perceptual resonance'. Building on research showing that entry of action-related urges is associated with the activation of conflicting action plans, Study 3 (n = 21) revealed that conflict in the Stroop color naming task is systematically associated with entry of metacognitions of exerted effort, $F(3, 54) = 10.694$, $p < .0001$. Together, the findings are consistent with the hypothesis that action-related entry is primarily a function of perceptual resonance and of the processing dynamics associated with action conflict. The potential neural correlates of action-related entry are reviewed.

D99

CO-LATERALIZATION OF PRAXIS AND SPEECH IN INDIVIDUALS WITH TYPICAL AND ATYPICAL LANGUAGE DOMINANCE Guy Vingerhoets[1], Ann-Sofie Alderweireldt[1], Pieter Vandemaele[1], Qing Cai[1], Lise Van der Haegen[1], Marc Brysbaert[1], Eric Achten[1]; [1]Ghent University, Belgium — We determined the neural correlates of word generation and tool use pantomiming in healthy subjects with typical (n=10) or atypical (n=10) language dominance to investigate similarities in activation pattern and hemispheric specialization between language and praxis. All typical language dominant volunteers also revealed left hemisphere activation during tool use pantomiming in prefrontal, premotor, and posterior parietal regions. All atypical language dominant participants displayed right hemisphere activation for tool use. Co-lateralization of the language and praxis networks was observed on group and individual level, regardless of the participant's handedness. Activation maps of the word generation and tool use pantomiming contrasts displayed overlap in five cortical regions: supplementary motor area, dorsal and ventral premotor cortex, dorsolateral prefrontal cortex, and posterior parietal cortex. Individual lateralization indices were calculated for each region and revealed significant positive group correlations between .51 and .95 with every other region within the paradigms. Positive cross-task correlations ranged between .72 (supplementary motor complex) and .97 (dorsal premotor cortex) and illustrate that the strength of hemispheric specialization of one task significantly predicts the side and degree of lateralization of the other task, suggesting a functional and topographic link between language and praxis. These findings support models that link gestures and speech to explain the evolution of human language. We argue that the existence of a common and co-lateralized network underlying the production of complex learned movement, whether it be speech or tool use, may represent the evolutionary remnant of a neural system out of which proto-sign and proto-speech co-evolved.

D100

THE NEURAL EFFICIENCY OF ACTION PLANNING: DIFFERENCES IN ERD BETWEEN HIGH AND LOW WORKING MEMORY GROUPS Lawrence P. Behmer Jr.[1], Lisa R. Fournier[1], Sabrina Gonzales[1], Jeromy R. Roach[1]; [1]Washington State University — The "Neural efficiency" hypothesis suggests that neural activity is reduced in individuals with greater intelligence, expertise, and/or working memory capacity. Several studies have been able to demonstrate this phenomena using EEG. For example, high-IQ individuals have been shown to demonstrate less alpha/mu-desynchronization (mu-ERD) during cognitively demanding tasks than low-IQ individuals. Young participants showed less alpha/mu-ERD than seniors during self-initiated movements. EEG research investigating the mirror neuron phenomena has revealed similar patterns of mu-ERD when individuals observe not only goal directed actions, but stimuli associated with a learned motor program. After using the AOSPAN to segregate individuals into high and low working memory span groups, we employed EEG to measure mu- and beta-ERD over the Rolandic strip while they performed a task which required them to hold an action plan in working memory, made up of a series of learned movements associated with an abstract visual stimulus. We found that both groups showed significant mu- and beta-ERD while planning their response during the task. Additionally, low-span participants showed overall greater mu-ERD than the high-span participants. Finally, low-span participants showed similar levels of mu-ERD in both hemispheres, regardless of which hand they used to plan their response, while high-span individuals only showed mu-ERD in the hemisphere which was contralateral to their planning hand. We suggest that these increased levels of mu-ERD in the low-span participants may be an indication of the need to recruit greater neural resources during sensorimotor tasks which place a load on working memory systems.

D101

DYSFUNCTIONAL FORWARD MODEL MECHANISMS AND ABERRANT SENSE OF AGENCY IN OBSESSIVE-COMPULSIVE DISORDER Antje Gentsch[1,2], Simone Schütz-Bosbach[1], Tanja Endrass[2], Norbert Kathmann[2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Germany, [2]Humboldt-Universität zu Berlin, Germany — Patients with obsessive-compulsive disorder (OCD) lack the experience of action completion and agency. This subjective experience has been shown to depend on the integrity of predictions of action outcomes generated by forward models

of the motor system. Motor predictions are critical for inhibitory gating of actions and their consequences, and abnormal activity in motor control circuits, including basal ganglia and premotor cortex, has been found in OCD. This is the first study explicitly investigating forward model mechanisms in OCD. To test whether inhibitory gating based on motor predictions is physiologically altered in OCD, we used electroencephalography to measure N1 suppression during active generation and passive observation of visual feedback in 18 OCD patients and 18 healthy control subjects. Predictability of action feedback was manipulated on the basis of action and external cues, and simultaneous agency judgments were assessed. OCD patients did not show the typical N1 suppression to actively generated feedback as compared to passively observed feedback. Moreover, in OCD patients, the N1 was not modulated by additional predictive motor cues as observed in control subjects. If explicitly asked to report agency experience, enhanced estimations were found in patients, which correlated with the strength of incompleteness feelings. OCD patients fail to predict and suppress the sensory consequences of their own actions. The constant mismatch between expected and actual outcome caused by this forward model dysfunction may explain the persistent feeling of incompleteness even after properly executed actions and the obsessed searching for control in these patients.

D102

EFFECTS OF PHYSICAL FITNESS LEVEL ON INTERHEMISPHERIC COMMUNICATION ACROSS THE LIFESPAN Keith McGregor[1,2], Atchar Sudhyadhom[1,2], Nouman Mujahid[1], Carolynn Patten[1,2], Todd Manini[2], Joseph Nocera[1,2], Bruce Crosson[1,2]; [1]Malcom Randall VA Medical Center, [2]University of Florida — Aerobic fitness has been shown to be a buffer against aging related changes in the human neural system (Erikson et al., 2011; McGregor et al., 2011; Voelcker-Rehage et al., 2010). In the human motor system, recent evidence from neuroimaging and neurophysiological studies has indicated that aging may be associated with changes in interhemispheric communication (Talelli et al., 2008; Bernard & Seidler, 2011). However the effects of aging and fitness on such communication in midlife remains unexplored. We tested the effects of aerobic fitness on communication between the right and left primary motor areas using transcranial magnetic stimulation (TMS) and functional magnetic resonance imaging (fMRI) on a cross-section of 15 aerobically active and 15 sedentary middle aged (40-60 years) adults. Data from 15 sedentary and 15 aerobically active younger adults (18-25 years) were also acquired for comparison. Data from BOLD fMRI indicate that even in middle age sedentary individuals show increased bilateral recuitment sensorimotor areas. Further ipsilateral positive BOLD activity is negatively correlated with ipsilateral inhibition (ipsilateral silent period) and unimanual motor performance (reaction time & dexterity).

THINKING: Decision making

D103

BRAIN RESPONSES DURING ANTICIPATION VERSUS OUTCOME IN GAIN AND LOSS LEARNING IN SCHIZOPHRENIA Jenna M. Reinen[1], Catherine Insel[1], Sergio Francis M. Zenisek[1], Maggie S. Close[1], Daphna Shohamy[1], L. Fredrik Jarskog[2], Tor D. Wager[3], Jochen Weber[1], Edward E. Smith[1,4]; [1]Columbia University, [2]University of North Carolina, Chapel Hill, [3]University of Colorado, Boulder, [4]New York State Psychiatric Institute — Schizophrenia (SZ) is a disease involving abnormal dopamine signaling and motivational deficits. These symptoms have been associated with behavioral deficiencies in reward anticipation but not necessarily the experience of receiving reward. Furthermore, neuroimaging (fMRI) studies have shown that patients with SZ have abnormal activation in brain systems supporting reward learning. However, it is unclear how brain systems underlying anticipation and experience of reward differentially contribute to abnormal goal-directed and approach behavior. To dissociate the neural bases of reward learning, anticipation, and outcome in SZ, we tested patients and controls on a reward-learning task that separates choice, feedback, and outcome while undergoing fMRI. On each trial, subjects chose between two stimuli which were probabilistically associated with feedback (Correct/Incorrect), and after feedback received reward outcome. Each subject performed this task in two separate conditions: gain, in which correct feedback was associated with winning money, and loss, in which correct feedback was associated with avoiding losing money. Behavioral results indicated that patients performed worse than controls in both conditions. Patients were also less likely to use an extended history of feedback to make choices, but more so in the gain than the loss condition. Finally, imaging results showed decreases in SZ in orbitofrontal cortex and parahippocampal gyrus when making a choice and receiving reward, and these differences between groups were especially pronounced in the gain but not the loss condition. These results indicate that there may be abnormal activation in SZ both during the anticipation of rewards and the experience of receiving reward.

D104

BEHAVIORAL AND NEURAL DIFFERENCES BETWEEN RISK AND ATTRIBUTE FRAMING William Hedgcock[1], Irwin Levin[1], Kameko Halfmann[1], Natalie Denburg[1]; [1]University of Iowa — Framing effects occur when decision makers respond differently to problems that are described in positive or negative terms despite the fact that the problems are objectively identical. Several distinctive types of frames have been defined, yet these framing effects are often treated as a homogenous phenomenon. Two of the most common framing types that have been identified are risk and attribute framing. Risk frames involve a choice between a risky and a riskless option, and individuals typically have a higher preference for risky options when the problems are described in negative terms. In contrast, attribute frames involve evaluations where options are either risky or riskless and attributes, such as quality, are manipulated. Individuals typically give higher evaluations for options when the problems are described in positive terms. Here, we conducted a series of behavioral and functional magnetic resonance imaging studies to investigate processing differences in risk and attribute framing using a within subject valence manipulation. We found that negative risk framing increased risk taking, whereas negative attribute framing increased quality seeking. Behaviorally, the two types of framing were not correlated. Critically, attribute and risk frames activated distinct brain regions. Attribute framing was associated with regions involved in emotion processing, whereas risk framing was associated with regions related to numerical processing. We suggest that risk and attribute framing involve functionally different processes.

D105

REINFORCEMENT LEARNING MEDIATES RISK TAKING IN PARTICIPANTS AGED 5-YEARS-TO-ADULT David Paulsen[1], Michael Platt[1], Scott Huettel[1], Elizabeth Brannon[1]; [1]Duke University — Learning from feedback is critical for adaptive decision-making and dysfunction in feedback-learning mechanisms has been hypothesized to underlie pathological gambling. Both learning from negative feedback and risk-aversion develop slowly with age. We tested the hypothesis that these developmental changes are related. Participants 5-years-to-adult were administered a reinforcement-learning (RL) task to collect measures of learning from positive (FBPOS) and negative feedback (FBNEG), and one of two decision-making tasks. The decision-making tasks presented participants with a choice between a Sure and a Risky option towards collecting coins (Gains) and/or avoiding losing coins (Losses). In the RL task, age predicted learning from feedback. For Gains, increases in age, FBNEG, and FBPOS, each decreased the probability of choosing the risky option. In contrast, for Losses, increases in age and FBNEG increased the probability of choosing the risky option, while increases in FBPOS decreased the probability of choosing the gamble. Mediation analysis showed that FBNEG partially mediated the effect of age on choosing a gamble. Our findings provide support for the idea that risk-aversion for gains and risk seeking for losses are influenced by sensitivity to negative feedback. These data are also consistent with different underlying mechanisms for positive and negative feedback learning, and suggest that the development of these mechanisms contribute to the emergence of adult norma-

tive risk-aversion. In conjunction with data showing a strong connection between RL and dopamine function, these findings suggest future lines of research on the relationship between the development of dopamine function and risk-taking behavior.

D106

THE IMPACT OF TESTOSTERONE ADMINISTRATION ON TRUST, RISK, BETRAYAL, AND RECIPROCITY. Maarten Boksem[1,2], Pranjal Mehta[1,2], Bram van den Bergh[1], Veerle van Son[2], Alan Sanfey[2], Ale Smidts[1]; [1]Rotterdam School of Management, Erasmus University, [2]Donders Institute for Brain, Cognition and Behaviour, Radboud University — Testosterone has been associated with increased preferences for risk, while it is also proposed to play an important role in social interactions. Because trust is often regarded as 'social risk', we examined whether Testosterone differentially affects the decision to trust and the decision to take risks, by comparing a binary-choice Trust Game with a structurally identical, binary-choice Risk Game offering a good or a bad outcome. We elicited subjects' minimum acceptable probabilities (MAPs) of recieving the good outcome such that they would prefer the gamble to the sure payoff. Of our 49 participants (all females), 24 received Testosterone, while 25 received Placebo (double blind). In the Testosterone condition, first movers state higher MAPs in the Trust Game than in situations where nature determines the outcome, while subjects in the Placebo condition showed no such difference. In addition, subjects completed a series of lottery choices and played a one-shot Trust Game. The results revealed no difference in risk-attitude. In contrast, subjects in the Testosterone condition invested significantly less in their partners as a first-mover in the Trust Game, while they actually reciprocated more when they played as a second-mover. These results suggest that for subjects with high Testosterone, a trust-decision entails an additional risk premium to compensate for the potential costs of trust betrayal, leading to diminished trusting behaviour. At the same time, however, Testosterone enhanced reciprocity of revealed trust. We suggest that the impact of Testosterone on the drive to obtain and maintain social status may explain the present findings.

D107

SOCIAL LEARNING OF TRUST Catalina Ratala[1,2], Luke Chang[3], Aysegul Cetinkaya[2], Alan Sanfey[2,4]; [1]Erasmus Research Institute of Management, [2]Donders Centre for Cognitive Neuroimaging, [3]University of Arizona, [4]Behavioral Science Institute — Trust is the lubricant of social interactions (Zak & Knack, 2001). Daily life often confronts us with the decision of whether to trust the people, brands and institutions we come in contact with. As individual experience shows, there is a potential downside associated with trusting: the risk of being betrayed. Given this constraint, how do we decide whom to trust? Several studies demonstrate that people rely on information from previous interactions to assess others' trustworthiness: we learn who to trust. However, we also have strong prejudice about who we should trust. Experimental evidence shows that there are in-built mechanisms by means of which we automatically evaluate the trustworthiness of interaction partners. The information used to judge trustworthiness is partially encoded in facial features and emotional expressions. The present study uses fMRI to investigate the relationship between automatic judgments of trustworthiness and experience-based judgments in a social decision-making environment (Trust Game). We were able to disentangle the complex relationship between "first impressions" and learning: while left amygdala activation correlates with initial trust based on implicit mechanisms of face evaluation, the subsequent learning of trust is strongly driven by the probability of reciprocation in the latter stages of the interaction, and is reflected by activity of the caudate nucleus.

D108

NEURAL CORRELATES OF CONFLICT WHEN CHOOSING BETWEEN THINGS WE WANT Amitai Shenhav[1], Randy L Buckner[1,2,3]; [1]Harvard University, [2]Massachusetts General Hospital/Harvard Medical School, [3]Howard Hughes Medical Institute — When studying neural systems involved in decision conflict, focus is typically on decisions (a) between options of moderate personal significance and/or (b) with correct responses defined by the experimenter or learned through feedback. As a result, trials with the greatest conflict in these studies often present the greatest chance of committing an error and needing to subsequently learn to correct one's behavior. We instead explored choice conflict generated by participants' own preferences over products they cared about and could actually receive (e.g., cameras, iPods, DVDs). While in the scanner, participants (N=42) made time-pressured choices between product pairs that varied in relative subjective value (as measured by an earlier task). Participants also provided post-scan ratings of each choice pair, including a surprise opportunity to adjust their previous choices, with varying degrees of confidence. As expected, participants were more likely to switch their earlier choices and were less confident in their final choices when choosing between similarly valued items. Participants reported substantially greater anxiety when confronted with similarly high-valued options versus when they chose between dissimilarly or similarly low-valued options. BOLD activity in the bilateral anterior insula and dorsal anterior cingulate cortex (ACC) predicted the likelihood that participants would later switch their choice, and also predicted retrospective ratings of choice-induced anxiety. These results are broadly consistent with putative roles for ACC and insula in detecting response conflict and/or risk associated with a decision, and suggest that this extends to cases in which conflict is driven by personal preference over real potential outcomes.

D109

NEURAL CORRELATES OF CREDIT ASSIGNMENT TO CURRENT AND PAST CHOICES IN A DYNAMIC DECISION-MAKING TASK Darrell Worthy[1], Marrissa Gorlick[2], Jeanette Mumford[2], Akram Bakkour[2], Russell Poldrack[2], W. Todd Maddox[2]; [1]Texas A&M University, [2]University of Texas at Austin — We used fMRI and a two-choice dynamic decision-making task to investigate the neural correlates of credit assignment to current and past choices. Optimal performance on the task involved ignoring the short-term benefits of one option (the Decreasing option) and instead selecting the other option (the Increasing option) which had lower short-term payoffs but whose continued choice led to greater long-term cumulative reward. We tested whether brain activation was parametrically modulated according to the prediction errors from two models. The first model we used is a standard temporal difference (TD) model which gives credit for the reward received only to the option chosen on each trial. The second model, the Credit Assigned to the Previous choices (CAP) model, assumes that participants assign credit for the reward received on each trial to the options they chose on previous trials. Thus, this model assumes that participants expect to be rewarded for their actions on future trials, rather than immediately. Ten young adults performed the task while in the fMRI scanner. Prediction errors from the standard TD model, which gave credit only to the option chosen on each trial, were correlated with bilateral activity in the caudate, putamen, and lateral OFC. Prediction errors from the CAP model, which gave credit only to options chosen in the recent past, were correlated with bilateral activity in the medial OFC. This suggests that the medial OFC plays a role in evaluating how past actions affect future consequences, in the form of positive or negative prediction errors.

D110

USING COMPUTATIONAL MODELING TO INVESTIGATE THE NATURE OF DECISION-MAKING PROCESSES IN HEROIN AND AMPHETAMINE USERS Jasmin Vassileva[1], Woo-Young Ahn[2], Georgi Vasilev[3], Kiril Bozgunov[3], Ivaylo Raynov[3], Rada Naslednikova[3], Jerome Busemeyer[2]; [1]University of Illinois - Chicago, [2]Indiana University - Bloomington, [3]Bulgarian Addictions Institute — Although substance dependent individuals (SDIs) commonly show decision-making deficits, it remains unclear whether these deficits persist after discontinuation of drug use and whether the nature of the decision-making processes is the same in users of different types of drugs. To investigate this question, we used computational modeling to disentangle the psychological processes involved in deci-

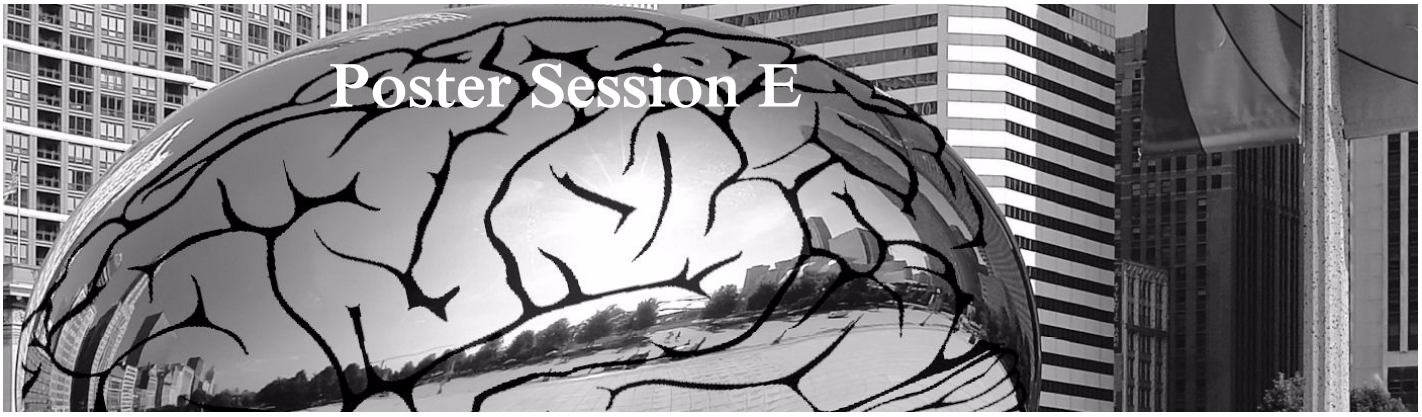
sion-making in a unique sample of relatively "pure" heroin and amphetamine SDIs in Bulgaria. Participants included 169 individuals classified into one of the following groups: (1) healthy controls without history of drug dependence (n=60), (2) SDIs with past dependence on heroin (n=64), (3) SDIs with past dependence on amphetamines (n=45). We administered the Iowa Gambling Task (IGT) and examined both behavioral performance on the task and model parameters derived from computational modeling. Past users of either amphetamines or heroin performed significantly worse than healthy controls on the IGT. Computational modeling results revealed relatively selective deficits in learning/memory and punishment sensitivity in the two drug using groups relative to controls. The learning/memory parameter was inversely related to number of years of drug use in the heroin group but not in the amphetamine group. Similarly, punishment sensitivity was positively related to length of abstinence in the heroin group but not in the amphetamine group. Our results indicate that decision-making deficits are longstanding and suggest that these deficits are related to specific drug-using characteristics in heroin users, whereas other mechanisms may be at play in amphetamine users.

D111

EVOLVING BRAIN ACTIVITY PRIOR TO A CATEGORICAL DECISION REFLECTS THE STRENGTH OF GRADUALLY ACCUMULATING CHOICE PROBABILITIES Mark E. Wheeler[1], Sarah Woo[1], Joshua Tremel[1], Tobin Vijayin[1], Amanda Collier[1], Elisabeth Ploran[2], Tianming Yang[3]; [1]University of Pittsburgh, [2]George Mason University, [3]National Institutes of Health — Functional magnetic resonance imaging was used to measure whole-brain activity during a simple binary decision task in which choices (left vs. right) were informed by summing a series of learned prior probabilities. Our aim was to identify brain regions tracking the strength of probabilistic evidence accrued over time. Twenty subjects learned to associate six geometric shapes with a left- (L) or right-hand (R) response with three different degrees of evidene strength (weight) per hand: weak, medium, and strong. At scanned testing, subjects saw a series of four shapes and made an L or R choice informed by the sum of weights. Trials were evenly sorted into one of three possible progressions of evidence: rapid (consistent evidence), gradual (e.g., evidence gradually shifts from R to L), and switch (e.g., evidence builds rapidly toward R, switches rapidly to L). Logistic regression indicated that the individual shapes influenced choice according to the rank-order of their weights. Activity only in premotor areas, including the supplementary motor area, modulated according to both the response-hand and the progression of evidence prior to choice, with greater pre-response activity on rapid than switch trials. In contrast, activity in regions located in frontal and parietal lobes, as well as pre-supplementary motor area and striatum, did not modulate according to response hand and was negatively correlated with evidence, increasing most for switch and least for rapid trials. The data suggest that the accumulation of choice probabilities in this bimanual task occurs at the motor planning stage of decision making.

D112

ATYPICAL DECISION-MAKING IN YOUTH WITH AUTISM SPECTRUM DISORDER: RISK AVERSION AND REDUCED SENSITIVITY TO REWARD Shannon Johnson[1], Jillian Filliter[1], Tim Pleskac[2]; [1]Dalhousie University, Halifax, Nova Scotia, [2]Michigan State University — Recent evidence suggests that brain reward systems may differ, both structurally and functionally, in individuals with autism spectrum disorder (ASD; Schmitz, 2008). Our previous findings (Johnson et al., 2006) of a risk-averse decision-making style, characterized by heightened attention to loss, also point to reward system dysfunction in ASD. In the current study, we used a multimethod, mathematical modeling approach to better understand differences in the processing of positive and negative outcomes in ASD. We administered a battery of experimental decision-making tasks, including the Iowa Gambling Task (IGT) and the Balloon Analogue Risk Task (BART) to 28 children and adolescents with ASD and 36 typically developing (TYP) comparison participants. Groups were match based on age, estimated IQ, and sex ratio. Traditional behavioural measures of performance were examined, as were parameters obtained from formal cognitive models of the IGT and BART. While no significant between-group differences emerged for IGT performance, participants with ASD made significantly fewer risky choices on the BART than TYP participants. Mathematical modeling results for the BART demonstrated that the ASD group was more consistent in their responses and less sensitive to rewards than TYP participants. Together, the BART results indicate a more conservative approach, less exploratory behaviour, and reduced reward motivation in the ASD group. These data provide additional evidence for a risk-averse decision-making style in ASD. Our findings also suggest that reported structural and functional brain differences in the reward systems of individuals with ASD are associated with observable differences in behavioural performance.



Poster Session E

Monday, April 2, 8:00 - 10:00 am, Exhibit Hall

ATTENTION: Other

E1

TESTOSTERONE EXPOSURE, LATERALITY, AND AUTISTIC TRAITS IN FEMALES Kathleen A. Flannery[1], Isaac N. Saidel-Goley[1], Ashley A. Motta[1], Erin E. Albiero[1]; [1]Saint Anselm College — Prior research has established that the 2D:4D ratio can serve as an indirect measure of prenatal testosterone exposure given that higher levels of testosterone in amniotic fluid samples are correlated with lower 2D:4D ratios. The purpose of this study was to examine whether the 2D:4D ratio would also be correlated with sexually dimorphic measures of laterality. Specifically, it was hypothesized that in females, lower 2D:4D ratios would be associated with greater left hemisphere specialization for language and stronger right hemisphere specialization for visuospatial attention. According to the Extreme Male Brain theory (EMB, Baron-Cohen, 2003) higher testosterone levels also contribute to males showing lower levels of emotional awareness, therefore we predicted that lower 2D:4D ratios would be associated with sexually dimorphic measures of personality such as autistic traits. The sample included 33 females who completed a dichotic listening task, landmark task, Autism-Quotient (AQ) questionnaire, Levels of Emotional Awareness Scale, and handedness questionnaire. Caliper measurements of the 2D:4D ratio (left hand) were significantly correlated with the landmark task, indicating that higher prenatal testosterone levels were associated with a stronger right hemisphere bias for visuospatial attention. Autometric measurements of the 2D:4D ratio (left hand) were significantly correlated with the communication subscale of the AQ, suggesting that higher levels of prenatal testosterone were associated poorer communication skills. These findings suggest that prenatal testosterone levels have a masculinizing effect on visuospatial attention and communication skills in females. This is consistent with established sex differences in laterality and predictions regarding personality traits based on EMB theory.

E2

CONTEXT-DEPENDENT MODULATION OF FORCE PRODUCTION IS DECREASED IN ADULTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD) Hilary Gomes[1], Jared Goldman[1], Karin Fisher[1], Clara Moisello[1], Felice Ghilardi[1], Jeffrey Halperin[2]; [1]City College of New York, [2]Mount Sinai Medical Center — Individuals with ADHD often exhibit increased variability in reaction times (RT), but little is known about other aspects of motor control. Force production can be modulated without awareness to respond appropriately to different contexts: movements to the same targets are performed with greater force and lower duration in random choice-RT tasks than in predictable, timed response tasks. Here, we used three tasks to determine whether in ADHD, implicit context-dependent force modulation is normal. Ten ADHD subjects (mean age = 24.6) and 13 controls (mean age = 23.3) performed three reaching tasks with fixed time-constraint responses: a choice-RT task in which targets appeared randomly (RAN); a timed-response task in which targets appeared in a predictable counter-clockwise order (CCW); and a sequence-learning task (SEQ), in which targets appeared in a fixed order, and subjects were explicitly asked to learn the target order and to anticipate target appearance. Moreover, during SEQ, force production indices of anticipatory movements implicitly shift from reaction to anticipation. Explicit sequence learning rate was similar in both groups. ADHD showed a decreased, although not significant, difference between CCW-RAN force production indices compared to controls ($p=0.12$). In controls, but not in ADHD ($p > 0.05$), force production indices of SEQ anticipatory movements were significantly different from those of movements in RAN ($p < 0.01$), with a significant net saving in energy. This result suggests that the implicit ability to optimize and modulate force production during reaching movement in response to changing contexts may be impaired in ADHD.

E3

INTEGRITY OF MEDIAL VISUOMOTOR PATHWAY PREDICTS BETTER RECOVERY IN NEGLECT PATIENTS RECEIVING PRISM ADAPTATION TREATMENT Priyanka Shah[1,2], Peii Chen[1,2], Kelly Goedert[3], Anne Foundas[4], A.M. Barrett[1,2]; [1]Kessler Foundation Research Center, West Orange, New Jersey, [2]University of Medicine and Dentistry of New Jersey (UMDNJ), Newark, [3]Seton Hall University, South Orange, New Jersey, [4]Louisiana State University, New Orleans, Louisiana — Objective: To determine whether lesion location predicts functional recovery in right-hemisphere damaged (RHD) patients with neglect following prism adaptation therapy (PAT). Background: PAT can produce substantial improvements in spatial neglect. Our previous studies suggested that PAT improved spatial bias in the "aiming" motor-exploratory domain, which may be subserved by frontal cortico-subcortical systems. Therefore, the current study examined whether frontal lesion involvement determined treatment response to PAT in post-stroke patients with spatial neglect, using motor-exploratory improvement in the Catherine Bergego Scale (CBS-ME) as the outcome measure. Design/Methods: Lesions of RHD patients (N=21) receiving PAT were manually mapped from clinical images (CT or MRI) using MRIcro. Based on the lesion-maps, we extracted information of frontal vs. no-frontal lesion involvement and conducted a multilevel modeling analysis (MLM). Results: After controlling for age and lesion size, MLM revealed that patients with frontal lesions demonstrated better improvement trajectory (n=13) than patients without frontal involvement (n=8). Therefore, we pursued a more detailed analysis on lesion-symptom relationship to elucidate which frontal-subcortical systems strongly support PAT response. The PAT-responsive group had greater integrity of 1) subcortical vs. cortical and 2) medial vs. lateral structures. Conclusions/Relevance: Our results showed that the medial visuomotor pathway critical for visually-guided movement may support PAT response. PAT may manipulate the network for visual sensorimotor adaptation, subserved by the spared thalamus and basal ganglia, which in turn may improve "aiming" motor-exploratory behaviors related to spatial neglect. It is still unclear from our preliminary data whether dorsolateral prefrontal regions may account for other performance variables.

E4

GREATER "AIMING" MOTOR-INTENTIONAL BIAS PREDICTS BETTER RECOVERY OF SPATIAL NEGLECT WITH PRISM ADAPTATION Kelly Goedert[1], Peii Chen[2,3], Raymond Boston[4], Anna Barrett[2,3]; [1]Seton Hall University, [2]Kessler Foundation Research Center, [3]University of Medicine and Dentistry New Jersey, [4]NBC School of Veterinary Medicine, University of Pennsylvania — Spatial neglect is a debilitating disorder in which patients fail to respond or initiate actions to contralesional stimuli. These patients often present with deficits in one or more brain-behavior spatial systems: They may experience spatial deficits affecting stimulus encoding : "Where", perceptual-attentional deficits. They may also experience deficits in motor preparatory spatial processing: "Aiming", motor-intentional deficits. We hypothesized that improved functional recovery in neglect patients undergoing prism adaptation treatment would be better predicted by baseline "Aiming" than "Where" spatial bias. A consecutive sample of 38 right-brain stroke patients presenting with left spatial neglect performed two weeks of daily prism adaptation. At baseline we administered a laboratory assessment of "Where" and "Aiming" bias that entails fractionating subjects' error on a computerized line bisection task. We administered the Catherine Bergego Scale (CBS), which assesses left-right asymmetries in the performance of functional activities such as grooming and eating, at baseline and weekly thereafter for six weeks. Even though "Where" bias better predicted baseline CBS, a hierarchical linear model analysis, controlling for age and status at baseline, found that subjects with greater "Aiming" bias experienced greater functional recovery over the 6 week period (linear recovery rate: $b = -0.77, SE = 0.29, p = 0.009$); the extent of "Where" bias did not predict recovery ($b = 0.22, SE = 0.28, p = 0.425$). These results are consistent with our own and others' work suggesting that prism adaptation may selectively affect motor-intentional systems. Further, these results demonstrate the relevance of this laboratory assessment of spatial bias to functional recovery.

E5

NEURAL BASES OF DECISION MAKING: AN ACCUMULATOR MODEL OF STOP SIGNAL PERFORMANCE Sien Hu[1], Yuan-chi Tseng[2], Alissa Winkler[1], Chiang-shan Li[1]; [1]Yale University, [2]Smith-Kettlewell Eye Research Institute — The stop signal task (SST) is widely used to study cognitive control. However, the mechanisms underlying decision making in the SST was rarely studied. Here, we developed a leakage accumulator model, modified from Ratcliff's diffusion model (1978), for a one-choice SST (Li et al., 2006), in which a go signal instructs participants to quickly respond and an occasional stop signal instructs participants to withhold the response. Forty-seven participants completed the SST during functional magnetic resonance imaging (fMRI). We performed multiple regressions on blood-oxygenation-level-dependent (BOLD) signals of go trials against the go trial reaction time (GORT), drift rate, and threshold, respectively. The effect size of activity changes for regions of interest were then correlated with the corresponding parameters. The results showed that activations in the right insula, thalamus/subthalamic nucleus (STN), right caudate, and pre-supplementary motor area (pre-SMA) are positively correlated with GORT. Drift rate negatively correlated with activations in the right insula, thalamus/STN, and SMA; threshold positively correlated with activation in the right caudate. These results revealed distinct regional activations mediating components in the processes of decision making: the right anterior insula and thalamus/STN was associated with a lower drift rate, and the right caudate was associated with a higher threshold, while all of them positively correlated with GORT. To our knowledge, this is the first study to investigate the neural processes of decision making in a one-choice SST. The results also identify critical roles of the anterior insula, thalamus/STN, and the caudate in decision making that involves a speed-accuracy tradeoff.

E6

ALTERATIONS IN MIND WANDERING AFTER DAMAGE TO HUBS OF THE DEFAULT MODE NETWORK Carissa Philippi[1], David Rudrauf[2], Daniel Tranel[3]; [1]University of Wisconsin-Madison, [2]University of Iowa, Iowa City — While in our daily lives mind wandering (MW) can occupy a significant proportion of our thoughts (e.g., planning a meal while in line at the store), the neural correlates of MW remain unknown. The default mode network (DMN), a network of brain regions with high metabolic activity at 'rest' (without an active cognitive task), has been consistently implicated in MW. We sought to test the hypothesis that the medial prefrontal cortex (mPFC) and inferior parietal lobule (IPL) hubs of the DMN are critical for MW using a targeted lesion approach. We assessed MW frequency in seven patients with mPFC damage and six patients with IPL damage using a sustained attention to response task (SART), and a 12-item self-report MW subscale of the Imaginal Processes Inventory. Contrary to the hypothesis, mPFC and IPL groups made significantly more errors on the SART than the comparison groups. For the MW questionnaire, mPFC and IPL groups reported MW significantly less than the comparison groups. Thus, DMN damage was associated with increased errors on the SART and decreased awareness of MW. In contrast to our hypothesis, our findings suggest that the DMN may be critical for the meta-awareness of MW. Besides the DMN, recent work suggests that the frontoparietal network (FPN) is also engaged during MW and functions to shift attention to focus on internal autobiographical thoughts. Thus, it is possible that damage to the DMN could disrupt the generation of internal thoughts while sparing the ability of the FPN to shift attentional focus internally.

E7

BORED TO DEATH: EXPLORING APATHETIC AND AGITATED SUBTYPES OF BOREDOM PRONENESS. James Danckert[1]; [1]Department of Psychology, University of Waterloo — Boredom is a common human experience researched within a broad context including human factors, clinical, social and personality psychology. Despite this, little work has examined the cognitive constructs associated with boredom, even in populations (i.e., traumatic brain injured patients) reporting elevated levels of boredom. Some suggest that lapses in everyday attention (e.g., pouring orange juice on cereal), or mindlessness, are a precursor to boredom. Work in our lab demonstrated that boredom represents a unique emotional construct, distinct from depression, apathy and anhedonia. Next, we showed that when induced into a state of boredom, individuals demonstrate increased heart rate and decreased galvanic skin conductance levels. This pattern, known as 'directional fractionation', is indicative of reduced attention associated with the bored state. In addition, boredom was associated with elevated cortisol levels indicating the experience is aversive. Finally, in two studies exploring the relationship between boredom and sustained attention we found that performance could be split based on two distinct types of boredom. First, an apathetic state in which individuals are unmotivated, is characterised by a preponderance of attention lapses with improvement seen when external incentives are added. Second, the agitated state, in which individuals are motivated to engage in stimulating activities but all attempts to do so fail, is characterised by an insensitivity to errors, and a strong association with hyperactive symptoms of attention deficit hyperactivity disorder. Collectively, this work highlights the fact that boredom can be characterised in two distinct ways with each subtype showing a distinct cognitive profile.

E8

INCENTIVE EFFECTS ON BEHAVIOR AND P3 IN A GO/NOGO PARADIGM WITH LOTTERY-TYPE REWARD David S. Leland[1], Catherine L. Reed[2], Jacob L. Bradley[1], Paige M. Jablonski[1], Kellyn A. Kroner[1]; [1]University of Wisconsin - Eau Claire, [2]Claremont McKenna College — The P3 is an event-related potential (ERP) component associated with stimulus evaluation and categorization, typically evoked by stimuli under conditions of selective attention, low frequency, high task-relevance, and/or high motivational salience. Prior research investigating the influence of motivation on the

P3 has focused primarily on cued target detection tasks or decision-making tasks in which P3 is evoked by reward feedback. Participants in these studies typically earn money based on individual performance. We are exploring the impact of high and low incentive stimuli on behavioral performance and P3 amplitude in a 50/50 go/nogo paradigm with no trial-by-trial cue or feedback stimuli. Participants are entered into a weighted random drawing for $25/$50 gift cards, to be conducted at the end of the study, with odds of winning proportional to points earned relative to other participants. Preliminary findings suggest that response accuracy is greater in high incentive (5 point) than low incentive (2 point) conditions, although reaction time does not differ. Target ERPs reveal a centroparietal positive component peaking at ~380ms in both conditions, but with no significant difference between them. These initial results suggest that the P3 can be evoked by targets that have the same frequency, task-relevance, and incentive value as nontargets in a paradigm with delayed, uncertain, and ultimately improbable reward. We speculate that a more powerful incentive manipulation may yield P3 effects that correspond to behavioral differences and that with such modification this paradigm can help broaden our understanding of the contexts in which motivation influences cognitive processing.

E9

N-METHYL-D-ASPARTATE RECEPTOR 2B SUBUNIT (GRIN2B) GENE VARIATION IS ASSOCIATED WITH ALERTING, BUT NOT WITH ORIENTING AND CONFLICTING IN THE ATTENTION NETWORK TEST Stefanie Schulz[1], Larissa Arning[1], Marlies Pinnow[1], Jörg T. Epplen[1], Christian Beste[1]; [1]Ruhr-University Bochum, Germany — Appropriate attention levels are pivotal for cognitive processes, and individual differences in attentional functioning are related to variations in the interplay of neurotransmitters. The attention network theory reflects attention as a non-homogenous set of separate neural networks: alerting, orienting and conflicting. In the present study, the role of variation in GRIN2B, which encodes the NR2B subunit of N-methyl-d-aspartate (NMDA) receptors, was explored with regard to the regulation of arousal and attention by comparing the efficiency of the three attentional networks as measured with the Attention Network Test (ANT). Two synonymous SNPs in GRIN2B, rs1806201 (T888T) and rs1806191 (H1178H) were genotyped in 324 young Caucasian adults. Results revealed a highly specific modulatory influence of SNP rs1806201 on alerting processes with subjects homozygous for the frequent C allele displaying higher alerting network scores as compared to the other two genotype groups (CT and TT). This effect is due to the fact that in the no cue condition faster reaction times were evident in participants carrying at least one of the rare T alleles, possibly as a result of more effective glutamatergic neurotransmission. Another explanation could be a ceiling effect, meaning that subjects cannot be physically aroused in excess to a certain level. Altogether, the results show that variations in GRIN2B have to be taken into consideration when examining attentional processes.

E10

PHASE RESETTING OF DYNAMIC ATTENDING SIGNALS Karl Doron[1], Mari Riess Jones[2], Hermann Hinrichs[3], Michael Gazzaniga[1,4]; [1]University of California, Santa Barbara, [2]Ohio State University, [3]Otto Von Guericke University of Magdeburg, [4]Sage Center for the Study of the Mind — Attention to events in the natural environment can be controlled by temporal context. An oscillatory process that is capable of entraining to rhythmic sequences can model the neural and behavioral results observed in some attention experiments. An important aspect of an entrained oscillator is its flexibility: it demonstrates a capacity to adjust its period and phase to changes in the external driving rhythm. These adjustments to external rate changes can be observed in phase resets of an entrained EEG or MEG signal. To date, no studies in humans have investigated low frequency entrainment to a rhythmic visual stimulus, nor have phase resets to temporal perturbations been reported. Here, we report phase resetting in MEG signals recorded during rhythmical presentations of a lexical decision task. The phase of the delta band (1-3Hz) and the period of amplitude peaks in the alpha band (8-12Hz) entrain to the stimulus rate (1.667Hz) and also demonstrate phase shifts to temporal perturbations (+/- 120ms). These results show that neural oscillations in humans entrain to rhythmic visual input and further, that their adaptive behavior conforms to that of a limit-cycle oscillator when a stimulus arrives out of phase with an expected onset time.

EMOTION & SOCIAL: Emotion-cognition interactions

E11

THE INFLUENCE OF ACUTE STRESS AND PROVOCATION ON AFFECTIVE PICTURE PROCESSING: AN EVENT-RELATED POTENTIAL STUDY Angelika Dierolf[1], Julia Fechtner[1], John Sollers[2], Ewald Naumann[1]; [1]University of Trier, Germany, [2]University of Auckland, New Zealand — Research has shown that the stress hormone cortisol is important for the regulation of social motivational processes. Besides, aggression is a common behavior which is frequently involved in changes in higher level information processing patterns. However, the influence of the interaction between cortisol and aggression on information processing has been hardly examined, even though there is some evidence that cortisol plays a crucial role in the attention to social threat and release of aggressive behavior. Thus, the aim of the present study was to investigate the effect of acute stress, the thereby caused cortisol release and provocation on information processing, specifically affective picture processing. 71 healthy subjects were randomly assigned to the socially evaluated cold pressor test or warm pressor test (control condition). Half of each group received high or low levels of provocation during the Taylor Aggression Paradigm. Afterwards, 144 emotional pictures with positive, negative or aggressive content were presented randomly for 2,5s. Throughout the experiment EEG was recorded and acute levels of salivary cortisol were collected on the basis of which stressed subjects were divided into cortisol-responders and -nonresponders. Established effects within the event-related potentials depending on the presented emotion could be replicated. Moreover, preliminary results indicate that event-related earlier (N200, P200), as well as later components (P300, slow waves) are complexly influenced by acute stress, cortisol and provocation, suggesting an effect on various stages of information processing of socially relevant stimuli. We interpret this as a change in attention and motivational significance due to the manipulation.

E12

THE INFLUENCE OF ACUTE STRESS AND PROVOCATION ON APPROACH AVOIDANCE MOTIVATION: AN EVENT-RELATED POTENTIAL STUDY Julia Fechtner[1], Angelika Dierolf[1], John Sollers[2], Ewald Naumann[1]; [1]University of Trier, Germany, [2]University of Auckland, New Zealand — Animal as well as human research has shown that cortisol, the endproduct of the hypothalamic-pituitary-adrenal (HPA) axis, plays a crucial role in the release of aggressive behavior (Kruk et al., 2004; Böhnke et al., 2010). Nevertheless, changes in informational processes, such as approach or avoidance tendencies that might contribute to the relation between cortisol and aggression have not yet been a subject of research. Thus, the aim of the present study was to investigate changes of brain processes while approaching or avoiding socially relevant stimuli (happy and angry faces) after being stressed and provoked. It was hypothesized more approach tendencies after stress induction and subsequent provocation, especially in response to angry faces. 72 healthy students (half male) performed an approach avoidance task with happy and angry faces before as well as after manipulation of acute stress and provocation. Subjects passed either the socially evaluated cold pressor test or a non-stressful control procedure, respectively. Provocation was realized by means of the Taylor Aggression Paradigm. Throughout the experiment EEG was recorded. Preliminary results indicate that event-related potentials are influenced by stress and provocation, resulting in changes of the N1 (100-150ms post-stimulus), P2 (150-200ms) and N2 (220-320ms) amplitude. These results

suggest an influence of stress and provocation on information processing of socially relevant stimuli.

E13

A SMELL IS MORE TO A FACE THAN A FACE TO A SMELL: ASYMMETRIC VISUO-OLFACTORY INTEGRATION IN PERCEIVING SUBTHRESHOLD THREAT Lucas Novak[1], Wen Li[1]; [1]University of Wisconsin - Madison — Multisensory integration is ubiquitous, facilitating perception beyond the limit of individual senses and providing special enhancement of weak sensory inputs. Despite much research in standard object perception, this mechanism has hardly been examined in emotion literature. Pairing face and odor stimuli containing minute, subthreshold negative emotion or neutral emotion combined with functional magnetic resonance imaging, we examined olfactory-visual synergy in threat perception in visual and olfactory modalities. Participants performed a bimodal discrimination task to paired olfactory and visual stimulus presentation in the MRI scanner. Both the visual and olfactory stimuli consisted of either neutral or minimally negative valence, ordinarily indistinguishable from each other. We found congruency-related improvement in detection of the subthreshold negative stimulus, primarily shown in improvement of negative face detection than negative odor detection. MRI results showed activation of left amygdala and hippocampus for congruent negative stimulus presentation versus congruent neutral stimulus presentation. Additionally, improvement in facial threat perception was paralleled by enhanced fusiform response to the minimally fearful faces in the presence of the weak negative odor versus the neutral odor. This augmentation was correlated directly with improved fearful face detection. The findings indicate cross-modal integration of affective processing localized to sensory cortex rather than prefrontal structures, indicating low-level sensory integration rather than higher-level appraisal of binary threats. Furthermore, the findings highlight an asymmetry of visuo-olfactory synergy in threat perception, aligning with the unique intimacy between olfaction and emotion and the predominant role of the visual sense in human perception.

E14

MEMORY FOR NEGATIVE EMOTIONAL STIMULI IS PREDICTED BY PUPIL DILATION AND ATTENTION-RELATED EYE MOVEMENTS TO SALIENT FEATURES Cory Inman[1], Stephan Hamann[1]; [1]Emory University — Previous studies have reported that increased narrowing of visual attention during picture encoding, as indexed by greater clustering of eye fixations, is associated with enhanced episodic memory. Recently, we reported that this effect was stronger for negative emotional pictures. Here we examined whether enhanced memory for emotional pictures is specifically related to increased attention to salient affective features, as measured by increased fixation time to salient features. Eye tracking and pupilometry were recorded while participants passively viewed positive, negative, and neutral pictures. After a brief delay, free recall and cued recall were tested. Attentional focusing on salient picture features was greater for both negative and positive emotional pictures relative to neutral pictures. Subsequent recall was predicted by increased attention to salient features, but only for negative pictures. In addition, as expected, increased emotional arousal at encoding was associated with greater pupil dilation, and this dilation also predicted subsequent memory for negative pictures. These findings suggest that the narrowing of visual attention for affective stimuli partly reflects increased attentional capture by salient stimulus features, which in turn is associated with richer encoding and successful subsequent memory. The specificity of the current memory findings to negative emotional stimuli may reflect attentional and memory biases that prioritize the processing of negative emotional stimuli. Preferential attentional capture by negative emotional stimuli and enhanced memory is consistent with an adaptive processing bias towards attending to and remembering potentially survival-relevant stimuli.

E15

INCREASED GRAY MATTER VOLUME IN THE RIGHT ANGULAR GYRUS OF LOVING-KINDNESS MEDITATORS OF LOW ANXIETY Mei-Kei Leung[1], Chetwyn C.H. Chan[2], Jing Yin[1], Chack-Fan Lee[1], Kwok-Fai So[1], Tatia M.C. Lee[1]; [1]The University of Hong Kong, [2]The Hong Kong Polytechnic University — Meditation is an experiential process that involves the cultivation of a specific internal or mental state. Previous studies have revealed that long-term practice of attention-focused meditation is associated with structural changes in brain regions which support for the cognitive processes of attentional control during practice. This study employed voxel-based morphometry to examine gray matter changes of practising loving-kindness meditation (LKM), which is emotion-oriented and involves the cultivation of unconditional love and compassion toward all sentient beings. A total of twenty-five men were scanned by a 3T MRI scanner. The meditation experts (n=10) had at least 5 years of experience in LKM and the matched novice controls (n=15) were naïve to but interested in meditation. Our results found a higher gray matter volume in the right angular gyrus (AG) in LKM experts. The specific roles of the right AG in perspective-taking and cognitive empathy are consistent with the focuses of LKM. Furthermore, novices had higher anxiety than experts, and the gray matter volume of their right AG was correlated negatively with their anxiety. This negative volumetric correlation with anxiety was absent for the right AG of experts. Therefore, we conclude that the enlargement in the right AG of LKM experts may serve to counter the adverse neural effects associated with anxiety. Our findings support for the use of LKM in therapy to counteract anxiety and promote mental well-being by providing an important initial clue of neuroplastic change in gray matter that may be related to the beneficial effect of practising LKM.

E16

THE EFFECT OF ANTICIPATION ON UNATTENDED EMOTION PROCESSING Renlai Zhou[1,2], Ming Peng[1], Alain De Beuckelaer[3,4]; [1]Beijing Key Lab of Applied Experimental Psychology (School of Psychology,Beijing Normal University), Beijing, China, [2]State Key Laboratory of Cognitive Neurosciences and Learning (Beijing Normal University), Beijing, China, [3]Department of Personnel Management and Work and Organizational Psychology and Centre for Social Theory, Ghent University, Belgium, [4]Institute for Management Research, Radboud University Nijmegen, The Netherlands — This study examined the influence of anticipation on emotion processing in those situations in which emotional information is unattended by asking 17 participants to perform a color stroop task under three conditions. In the random condition, both the presentation of the facial expression (fearful or neutral) and congruence between color (red/green) and word ("red"/"green") was randomized in every experimental trial. In the regular expression condition, the presentation of faces was predictable (i.e., a fearful face was always preceded by two subsequent neutral faces) and the presentation of faces was random. In the regular congruence condition, congruence between color and word was predictable (i.e., an incongruent trial was always preceded by two subsequent congruent trials) and the presentation of faces was random. The resulted revealed that, fearful faces induced larger amplitudes in P2 and P3 components than neutral faces in the random condition. The same difference was also observed in the regular expression condition. However, in the regular congruence condition, fearful faces only induced larger amplitudes in P2 components. The results showed that ERP components related to color stroop processing (N2, P3, N400) were affected by anticipation,. We concluded that: (a) unattended emotion may be processed both in early (P2) and late (P3) stages of processing, and (b) type of processing did not depend on whether or not emotional faces were presented in a predictable sequence. However, emotional faces were not processed in a late stage of cognitive processing (P3), whenever the congruence of the word/color combination was predictable

E17

SEX-RELATED DIFFERENCES IN THE RESPONSE TO ANXIETY-INDUCING DISTRACTION: AN EVENT-RELATED FMRI INVESTIGATION Alexandru Iordan[1], Sanda Dolcos[1], Florin Dolcos[1]; [1]University of Illinois at Urbana-Champaign — Previous investigations showed that the impact of task-irrelevant anxiety-inducing distraction on working memory (WM) performance was linked to opposite patterns of activation in emotional and perceptual (bottom-up) vs. cognitive control (top-down) brain regions. However, little is known about sex-related differences in these responses. The present study investigated this issue using event-related fMRI in 30 participants (16 females), who performed a delayed-response WM task with anxiety-inducing distraction (i.e., angry faces) presented during the interval between the memoranda and probes. Analysis of behavioral data showed that women were more sensitive to anxiety-inducing distraction, although there were no sex-related differences in the overall WM performance. Linked to these behavioral findings, analysis of fMRI data revealed sex-related differences in both bottom-up and top-down effects. Specifically, women showed undifferentiated amygdala activity in response to both emotional/angry and neutral/control face distracters, and enhanced activity to emotional distracters in the subgenual anterior cingulate cortex, whereas men showed increased activity to emotional distracters in the lateral prefrontal cortex. In addition, women and men showed opposing patterns of co-variation of activity in the medial-temporal lobe memory regions with WM performance – i.e., negative vs. positive, respectively. Collectively, these findings are consistent with evidence of enhanced emotional reactivity in women, contribute to the understanding of sex-related differences in the response to anxiety-inducing distraction in normal behavior, and have implications for understanding factors that may influence sex-related differences in the susceptibility to affective disorders.

E18

INVESTIGATING THE CIRCUMPLEX MODEL OF EMOTION: EVENT RELATED POTENTIALS (ERPS) FOR HIGH AND LOW AROUSAL NEGATIVE AUTOBIOGRAPHICAL MEMORIES Theodore Waters[1], Felicia Jackson[1], Patricia Bauer[1]; [1]Emory University — Increasing neurological evidence supports the Circumplex model of emotions, demonstrating that differential neural processing of emotion occurs along two dimensions: arousal (high/low) and valence (positive/negative). Currently, most fMRI and ERP studies examining emotion processing utilize IAPS stimuli (internationally normed emotion eliciting photographs), images of emotional faces, and/or emotion-eliciting words (e.g. Schupp et al., 2000). These stimuli reliably elicit emotional responses yet they (a) cannot be counterbalanced across conditions (high arousal pictures cannot serve as low arousal/neutral stimuli), leading to concerns about internal validity; and (b) lack personal relevance, an important feature in emotion processing, leading to concerns about external validity. In the present research we overcame these limitations by using an autobiographical memory cue word paradigm (recently adapted for ERP; Bauer et al., under review) that allowed us to counterbalance stimuli and examine personally relevant emotional materials. 50 adults (25 female) described emotional autobiographical events in response to neutral cue words. The cued memories were either neutral, low-arousal negative (e.g., sadness, loneliness), or high-arousal negative (e.g., anger, fear). ERPs were recorded while participants viewed the cue words on a computer and recalled the emotional events. Females showed emotion effects (i.e. differential processing of high and low arousal vs. neutral memories) at posterior midline sites. In contrast, males demonstrated arousal effects (differential processing of high and low arousal negative memories) at fronto-lateral sites. Implications for methodolocial approaches to emotion research and the circumplex model are discussed.

E19

EMOTION ENHANCES NEURAL PROCESSING DURING AUTOBIOGRAPHICAL MEMORY RETRIEVAL Felicia L. Jackson[1], Jennifer Strafford Stevens[1], Khaliliah Smith[2], Patricia J. Bauer[1]; [1]Emory University, [2]Agnes Scott College — Event-related potential (ERP) studies of adults often report an "emotion effect": preferential processing of arousing stimuli, regardless of valence. In contrast, school-age children devote additional neural resources to pleasant autobiographical memories, relative to unpleasant and neutral memories. This "happy effect" is observed at parietal electrodes, consistent with the emotion effect in adults. Because no study has examined adult ERPs during emotional autobiographical retrieval, it is unclear whether the difference in processing in children and adults is due to development, or stems from the nature of the stimuli (i.e., autobiographical events vs. pictures). We investigated this question by measuring ERPs as 46 young adults (23 female) recalled pleasant, unpleasant, and neutral autobiographical events. We prompted recall of 25 memories of each valence in response to neutral concrete nouns ("ball," "paper" etc). The valence associated with each word was counterbalanced across participants. During ERP recording, the words were presented one at a time to cue recall of the associated memory. ERP amplitudes for negative memories were less positive-going than for neutral memories: POz- $p = .02$, laterals (P3, P4, P7, P8)- $p = .01$. A similar trend was observed for positive versus neutral memories. These findings suggest that adults, like children, differentially process positive emotional events and over development come to differentially process negative events as well. This study illustrates a novel method for emotion elicitation that capitalizes on the naturalistic and personal aspects of autobiographical memories while controlling for perceptual stimulus effects on neural responses.

E20

COGNITIVE FUNCTION AS A MEDIATOR OF IMPULSIVE AGGRESSION FOLLOWING TRAUMATIC BRAIN INJURY Robin Wellington[1], Rebecca Abbott[1], Kristen Dams-O'Connor[2]; [1]St. John's University, [2]Mount Sinai School of Medicine — Introduction: Mild traumatic brain injury is a major public health concern with the annual incidence estimated at 150 per 100,000 population, accounting for 75% or more of all head injuries (Evans, RW 1993). Potentially, TBIs can result in negative outcomes across all domains of living. To our knowledge no study has directly investigated the role of cognition to negative behaviors post injury. Methods: 168 Participants were recruited by Research and Training Center throughout New York State. An interview assessing a broad range of psychosocial functioning was developed for the present study, revising and expanding upon the Quality of Life (QOL) and Health Interview (Mount Sinai School of Medicine, 1994). Results: Linear regression revealed a significant pathway between blows to the head (Blows) and emotionally inappropriate behavior (IEB) ($B=1.121$, $p<.01$). Blows was related to cognitive difficulties (CD) ($B=1.630$, $p<.01$), CD and IEB were related, when controlling for Blows ($B=.489$, $p<.01$) and the mediated pathway between Blows and IEB ($B=.324$, $p<.05$) was reduced from the original pathway. The mediation was found to be significant ($p<.001$; Sobel =5.559). Conclusions: Our results are indicative of the importance of cognitive function to the recovery process in TBI. Not only with respect to primary cognitive factors such as memory performance but also to the extent that a key component of cognitive function is to maintain control over impulsive or otherwise inappropriate behavior. Thus, cognitive integrity appears to mediate the degree of behavioral impulsivity.

EMOTION & SOCIAL: Emotional responding

E21

THE INVOLVEMENT OF ANTERIOR INSULAR CORTEX IN SOCIAL ANXIETY AND INTEROCEPTIVE SENSIBILITY Yuri Terasawa[1,2], Midori Shibata[2,3], Yukio Maehara[2,4], Yoshiya Moriguchi[1], Satoshi Umeda[2]; [1]National Center of

Neurology and Psychiatry, [2]Keio University, [3]Hokkaido University, [4]Japan Society for the Promotion of Science — Accessing bodily states underpins subjective experience of emotion, and the anterior insular cortex is an essential region for this process. The reactivity in this region during anticipation closely related with individual's levels of anxiety. To elucidate this mechanism, we examined the relationship between the activation in the anterior insular cortex and personality traits while participants evaluate their own emotional and bodily states. In the MRI scanner, participants were required to answer three types of question about; emotional state, bodily state and possessions. We presented a sentence as "I'm happy" or "I have a fast pulse", and participants evaluated and selected appropriateness of the sentence as a description for their current state from four options. Bodily sensibility score was calculated using the responses to bodily state condition. Personality traits were measured using some questionnaires. In the emotion trials, there was significant correlation between the right anterior insular activation and scores of neuroticism (r=.46), and social fear (r=.86). Multiple regression analysis revealed that the activation in left thalamus (somatosensory region), precuneus and supramarginal gyrus, during emotion trials correlated with bodily sensibility scores (p<.001, uncorrected). To disentangle the relationship between bodily sensibility and anxiety, mediation analyses were conducted. The result indicated that the right anterior insular cortex mediates the activation of left thalamus and levels of social fear (p <.03). Our findings provide direct evidence that high anxiety people tend to be too sensitive to bodily signals, and the greater attention to our own bodily state possibly contributes to development of anxiety disorder.

E22

DAMAGE TO THE VENTROMEDIAL PREFRONTAL CORTEX DISRUPTS NONCONSCIOUS FACIAL MIMICRY Jake Kurczek[1], Rupa Gupta[1], Melissa Duff[1]; [1]University of Iowa — When exposed to emotional facial expressions, participants nonconsciously mimic the expression. This form of covert mimicry can be observed through facial electromyography (EMG). Research reveals that the muscle groups associated with the production of a given expression become more active when viewing that expression compared to other facial expressions (i.e., greater activity of zygomatic major when viewing happy expressions compared to angry; greater activity of corrugator supercilii when viewing angry expressions compared to happy). Similarly, viewing emotional words also causes increased activity in the facial muscles involved in producing the associated facial expression (i.e., greater activity of zygomatic major when viewing the word joyous). This nonconscious facial mimicry may contribute to the ability to recognize, understand and empathize with anothers' emotions. Impairments in social and emotional functioning are one of the most pervasive results of damage to the ventromedial prefrontal cortex (vmPFC). Anecdotally, friends and family report that vmPFC patients lack compassion and empathy. We hypothesized that vmPFC damage would impair nonconscious facial mimicry. Here, 7 patients with bilateral vmPFC damage and 7 matched healthy comparison participants were exposed to happy and angry stimuli (facial expressions, words) while recording facial EMG activity from the corrugator supercilii (angry) and zygomatic major (happy) regions on the left side of the face. The vmPFC participants' facial EMG activity did not differ for happy and angry stimuli supporting the hypothesis that vmPFC damage impairs nonconscious facial mimicry. This disruption may contribute to their social/emotional deficits and may inform therapeutic interventions for social/emotional impairments.

E23

DO ALL THREATS WORK THE SAME WAY? ELECTROPHYSIOLOGICAL EVIDENCE FOR EARLY DIVERGENCE AND LATER CONVERGENCE IN FEAR AND DISGUST PROCESSING Elizabeth Krusemark[1], Wen Li[1]; [1]University of Wisconsin — The literature on threat processing is dominated by an almost exclusive focus on fear, resulting in limited knowledge about other meaningful threat emotions such as disgust. In two event-related potential (ERP) studies, we compared analysis of fear versus disgust emotions at early and later processing stages. Study 1 (N=43) examined early visual response (P1) to images eliciting disgust, fear or neutral emotion in combination with a visual search task immediately following images. ERPs indicated enhanced response to fear images and suppressed activity to disgust, relative to neutral images, together with facilitated response time for fear and delayed response for disgust (p's<.001). These findings suggest that fear and disgust instigate opposing early sensory and attentional processes. Study 2 (N=40) concentrated on the transition from early to later processing, with a special focus on how threat images modulated visual analysis of a neutral (Greeble) object presented about 425 ms later. Importantly, P1response to emotion images replicated effects observed in Study 1. Analysis of P1, N1, waveforms in 200-300 and 300-400 ms intervals at occipital sites in response to emotional images revealed a progressive trend to converge between fear and disgust (deviating from neutral). Visual ERPs (P1g and N170) to Greebles also conformed to a pattern of generalized threat encoding. In parallel, distance estimation of greebles was equivalent between fear and disgust trials (more proximal than neutral trials; p's<.01). Together, these results highlight the dynamic temporal course of threat processing, evolving from mandatory sensory classification to later functional convergence to motivate adaptive behavior.

E24

THE PERIPHERAL PHYSIOLOGICAL REACTIONS IN VIEWING TAIWANESE AFFECTIVE PICTURES Nai-Shing Yen[1,2], Chieh-Ning Lee[1], Tsung-Han Yang[1], Ching-Hui Chueh[1]; [1]Department of Psychology, National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan — To avoid cultural differences, Taiwanese Affective Pictures System (TAPS) had been developed to understand how Taiwanese respond to affective pictures. The present study recruited 34 subjects (half male) to judge valence and arousal levels (assessed by Self-Assessment Manikin) for 96 emotional pictures which were assigned into positive, erotic, neutral, bloody and negative categories from TAPS while peripheral physiological reactions included Heart Rate(HR)?Skin Conductance Responses(SCR)?Corrugators and Zygomatic Muscle (EMG) were recorded. The mean heart rates were highest for bloody and negative pictures (ps < .05), lowest for positive pictures, with neutral and erotic pictures in between. Bloody pictures also showed greatest corrugators changes than other categories, while erotic and negative pictures showed no differences with each other, but both significantly larger than neutral and positive pictures (ps < .05). Although zygomatic muscles changes did not reach significant level, subjects showed highest zygomatic muscles changes for positive pictures. SCR increased significantly for erotic and bloody pictures (ps < .05). Interestingly, although erotic pictures were rated as neutral behaviorally, the patterns of SCR and Corrugators muscles for erotic pictures were similar to negative pictures. Behavioral comparisons between male and female subjects suggested no gender differences on levels of valence and arousal across five categories. Male subjects however had decreased heart rates than female for neutral and bloody pictures between 0-3 seconds after picture onset. Male subjects also had increased corrugators muscles than female across all five categorical pictures which were opposite to what others had found.

E25

THE EXPERIENCE OF AN EMOTIONAL INDIAN SUMMER: RELATIVE VS. NORMATIVE EMOTIONAL DIFFERENTIATION IN DEPRESSION Mona El-Hout[1], Emre Demiralp[1], Renee J. Thompson[2], Jutta Mata[2], Susanne Jaeggi[1], Martin Buschkuehl[1], Lisa Feldman Barrett[3,4], Ian H. Gotlib[2], John Jonides[1]; [1]University of Michigan, [2]Stanford University, [3]Harvard Medical School, [4]Northeastern University — People constantly compare things, situations, and each other. Emotional experiences are no exception. Just like a person appears more appealing when contrasted with a less appealing person, a slightly less unpleasant momentary emotional experience can stand out in a lengthy epoch of intense sadness or anger. Therefore, it is

important to consider individuals' emotional experiences "relative" to their own individual baseline. For instance, an individual with depression who does not experience a pleasant emotional state for a whole week can have days that are less unpleasant than other days. Just like a slightly warm day in the dark of winter can feel like summer, slightly less unpleasant days could have positive connotations. In this study, we investigated whether the structure of "relatively" pleasant and unpleasant moments of emotional experience were different between depressives and controls. To test this hypothesis, we assessed emotional experiences of participants in daily life using an ecologically valid week-long experience sampling protocol. Depression was diagnosed using the Beck Depression Inventory and structured clinical interviews (SCID). Our results show that depression is associated with less differentiation of relatively positive emotional states compared to controls. Implications for basic and clinical science of emotion research are discussed.

E26

HEADS OR TAILS OR BOTH: EMOTIONAL DIALECTICISM IN DEPRESSION Leeanne Stickle[1], Kerry L. Traub[1], Emre Demiralp[1], Renee J. Thompson[2], Jutta Mata[2], Susanne Jaeggi[1], Martin Buschkuehl[1], Lisa Feldman Barrett[3,4], Ian H. Gotlib[2], John Jonides[1]; [1]University of Michigan, [2]Stanford University, [3]Harvard Medical School, [4]Northeastern University — Individuals' emotional experiences are rich and complex. Accordingly, a single emotion adjective rarely suffices to describe all aspects of an episode of subjective experience. Therefore, individuals often use multiple emotion adjectives to describe how they are feeling at a particular moment in time. Some adjectives (happy, alert and active) capture pleasant aspects of the subjective experience while others (sad, anxious and disgusted) capture the unpleasant aspects. Previous research shows that individuals vary tremendously in the degree to which they simultaneously use positive and negative emotional adjectives to evaluate and describe their subjective states. In this study, we used an ecologically valid week-long experience sampling protocol to assess depressed and healthy participants' subjective experiences in their daily lives. Participants were asked to use 4 positive and 7 negative emotion adjectives to rate their momentary emotional state. Depression was diagnosed using structured clinical interviews (SCID) and the Beck Depression Inventory (BDI). Our results show that depressives are more likely to simultaneously use positive and negative emotion adjectives when describing their subjective states. Implications of this finding for the basic science of emotion and clinical psychology are discussed.

E27

INTERPERSONAL SENSITIVITY AND EMPATHY IN INCARCERATED PSYCHOPATHS: FUNCTIONAL CONNECTIVITY ANALYSIS Laurie Skelly[1], Kent Kiehl[2], Jean Decety[1]; [1]University of Chicago, [2]University of New Mexico — A marked lack of empathy is a hallmark characteristic of psychopathy, but the brain basis of empathic processing has not yet been directly investigated in psychopathic individuals. We measured functional connectivity during perception of visual stimuli designed to elicit empathy for pain, using the amygdala as a seed region. Thirty-eight incarcerated males classified high (?28) and low (?20) in psychopathy using the Psychopathy Check List - Revised underwent functional magnetic resonance imaging while viewing dynamic stimuli depicting individuals causing pain to one another. Contrary to expectations, psychopaths exhibited marginally greater right amygdala activity than incarcerated controls in response to empathy-eliciting stimuli. Further, functional connectivity was reversed in the psychopath group in two key regions: the ventromedial prefrontal cortex (vmPFC) was negatively correlated with amygdala in controls as expected, but positively correlated in psychopaths; and anterior insula (AIC) was positively correlated with amygdala in controls, as expected, but negatively correlated in psychopaths. The finding of reversed vmPFC connectivity is anticipated by the literature, but it is surprising that right amygdala activity was marginally higher in the psychopath group. The AIC, critical for awareness of one's own affective states and for sharing the emotional states of others, has heretofore been excluded as a region of interest in psychopathy. These results impel a more nuanced view of amygdala dysfunction in psychopathy and a broadening of focus to include additional regions of interest in targeted investigations of psychopathy, especially the anterior insula.

E28

COMPARING CORTICAL PROCESSING OF EMOTIONAL FACES, WORDS, AND GESTURES: AN ERP STUDY Patrik Schoch[1], Johanna Kissler[1,2]; [1]University of Konstanz, Konstanz, Germany, [2]University of Bielefeld, Bielefeld, Germany — Humans are experts at extracting emotional information from visual media such as faces, words and gestures. Accordingly, many studies have investigated cortical correlates of emotional stimulus processing within these communicatory channels. The present study explores similarities and differences in cortical processing of emotional stimuli across all three communicatory channels. We recorded event-related brain potentials (ERPs) while participants viewed single words, gestures,, and faces with negative, neutral, and positive content. Stimuli were presented centrally for 150ms in a passive viewing task. Inter-trial interval was 1000 - 1300ms, preventing the problem of ERP component overlap that has been present in some previous experiments. For all types of stimuli, ERPs differed according to emotional content at early components (P1; N1; and Early Posterior Negativity, EPN). For faces, P1 and EPN were larger for negative stimuli than for neutral ones and N1 was reduced for positive facial expressions compared to neutral and angry faces. For words, N1 was larger for negative and positive compared to neutral words, resembling an arousal effect. Gestures showed significant P1 and EPN effects for positive stimuli. In sum, during viewing, emotional content affected early perceptual processing across all types of media. For biological stimuli, effects appeared already in the P1 window, whereas for symbolic word stimuli emotion effects were only seen for N1 component. Valence-specific effects were likewise restricted to biological emotional stimuli, with angry faces eliciting larger cortical responses than happy or neutral ones. By contrast, positive hand gestures elicited larger effects than negative or neutral ones.

E29

RELATING ANATOMICAL AND SOCIAL CONNECTIVITY: WHITE MATTER MICROSTRUCTURE PREDICTS EMOTIONAL CONTAGION Carolyn Parkinson[1], Thalia Wheatley[1]; [1]Dartmouth College — Empathy is comprised of 2 systems: an evolutionarily old emotion contagion system (emotional empathy; EE) and a cognitive perspective-taking system (cognitive empathy; CE). Because EE involves rapid, obligatory perception-action coupling, we hypothesized that higher EE would predict enhanced anatomical connectivity between regions involved in emotion perception and expression. Diffusion tensor imaging data (DTI) were analyzed using tract-based spatial statistics (TBSS) with fractional anisotropy (FA) as an index of structural integrity. EE and CE were assessed in 15 participants using the Interpersonal Reactivity Index. EE was associated with higher FA bilaterally in association fiber tracts linking perception and emotion-related, and perception- and action-related structures (superior, inferior and inferior frontal-occipital fasciculi), limbic association fibers, and the anterior thalamic radiations, which carry reciprocal connections from limbic structures to frontal cortex. CE was not significantly correlated with FA. Unlike EE, CE may not be strongly associated with FA because CE may not depend as heavily on rapid neural coupling between distant regions, and may comprise a less automatic process reliant on more domain-general neural substrates. These results provide a structural basis for associations between EE and automatic elicitations of sensory, motor and somatic representations of others' internal states, and establish a novel link between anatomical connectivity and social understanding.

LANGUAGE: Lexicon

E30

ERP EVIDENCE FOR EARLY MORPHO-ORTHOGRAPHIC DECOMPOSITION Joanna Morris[1], Phillip Holcomb[2], Jonathan Grainger[3,4]; [1]Hampshire College, [2]Tufts University, [3]University of Provence, [4]CNRS — Dual-route models of complex word recognition propose that there are two distinct sources of morphological influences on visual word recognition – sublexical morpho-orthographic segmentation and supralexical morpho-semantic processing. To test this hypothesis, we used the temporal sensitivity of event related potential recordings to directly examine the effects produced by the short masked presentation of complex nonwords (formed by the combination a legal stem and legal affix, e.g. huntity, cornity, scanity) on the recognition of semantically transparent complex words (e.g. hunter), semantically opaque pseudocomplex words (e.g. corner), and simplex words (e.g. scandal). We found a large early frontal N250 effect for transparent and opaque items but not for simplex items. Because this component is observed only for the stimuli that have morpho-orthographic structure (i.e., are composed of a stem and a suffix), we propose that this could be the first clear ERP evidence for morpho-orthographic decomposition.

E31

HOMOPHONE EFFECT IN CHINESE READING AND ITS NEURAL REPRESENTATION Wen-Jui Kuo[1], Ovid Tzeng[1]; [1]Institute of Neuroscience, National Yang-Ming University — In recent year, the role of phonology to orthography feedback consistency in visual word recognition has been a major challenge to the current models for reading. To tackle this issue is sometime problematic for the alphabetic writing system due to its nature of the high degree of coupling between grapheme and phoneme. Chinese, as an ideographic writing system, has approximately 1300 syllables which correspond to around 5000 characters. The pervasive homophony of Chinese implies the importance of a graphic form for selecting meaning and escaping homophony in reading Chinese. Most importantly, many Chinese homophone mates can be completely different in their orthographic patterns which provide a ground for a better understating of the feedback processing in visual word recognition. The present fMRI study manipulates the homophone density and character frequency in a lexical decision task. The reaction time data reveal the homophone density effect in reading low-frequency characters, and this psychological effect was mirrored in the left inferior temporal-occipital junction which a brain area emphasized for word from processing. The implication of how a orthographic form could benefit from the feedback connection from its homophonic mates will be discussed.

E32

ELECTROPHYSIOLOGICAL EVIDENCE FOR STEM ACCESS IN REGULAR AND IRREGULAR GERMAN PARTICIPLES Eva Smolka[1], Veronika Pöhnl[1], Carsten Eulitz[1]; [1]University of Konstanz — This study investigated whether German participles are decomposed and accessed via their stem or retrieved as whole words. The German participle formation is of particular interest, since it is concatenative for both regular and irregular verbs and results from combinations of regular/irregular stems with regular/irregular suffixes. Unlike previous electrophysiological studies that applied either violation paradigms or repetition priming to contrast regular and irregular inflection, the present study combined these two methods. Event-related potentials were measured when regular and irregular base verbs (werfen, 'throw') were primed by (a) their correct participles (geworfen, 'thrown'), (b) violated participles that illegally combined existing stems and participle suffixes (VPs, geworft, gewurft), and (c) matched unrelated participles (geholfen, 'helped'). Both regular and irregular participles facilitated their base. They induced strong left frontal negativities (LAN) as well as reduced centro-parietal negativities (N400 modulations) relative to the unrelated participles. Even though the effects by regular participles were more pronounced than those by irregular participles, the similarity of the effects argues for the same processing system. Furthermore, both regular and irregular VPs were as effective as correct participles in facilitating the base verbs, inducing strong N400 modulations and frontal negativities. This indicates that the stems in VPs were accessed, regardless of whether they originated from regular or irregular verbs. These findings strongly argue for a single system that processes both regular and irregular inflection via access to the stem. Such a single processing model is presented.

E33

LOCALIZING N400 EFFECTS OF PREDICTION WITH SIMULTANEOUS EEG-MEG Ellen Lau[1,2], Alexandre Gramfort[1], Scott Burns[1], Nate Delaney-Busch[1,2], Eric Fields[1,2], Kristina Fanucci[1,2], Phillip Holcomb[2], Matti Hamalainen[1], Gina Kuperberg[1,2]; [1]Martinos Center, Massachusetts General Hospital, [2]Tufts University — Previous research has demonstrated a reduction in the N400 response both when the prior context predicts the target word and when the target word is semantically associated with context words. In this simultaneous EEG-MEG semantic priming study, we use a relatedness proportion manipulation in order to isolate N400 modulation due to prediction, and we use MEG source localization to determine which cortical regions are responsible for this predictive modulation. In a long-SOA semantic priming design, we varied the proportion of related prime-target pairs (10% vs. 50%). Previous studies have shown that increasing relatedness proportion results in increased prediction for the target based on the prime. Here, ERP results (n=24) replicated these findings, demonstrating a robust N400 effect for associated targets in the high proportion condition but not in the low proportion condition. MNE distributed source solutions were used to localize the N400 effect in the high proportion condition. A whole-brain spatial clustering analysis of estimated source strength between 350-450ms showed significant differences in left temporal pole and left anterior STG. Timecourse analyses in a priori ROIs demonstrated significant differences in left temporal pole (323-443ms) but also in right IFG (358-460ms). Our results suggest that the observed N400 effect of prediction stems from differential activity in left anterior temporal and right inferior frontal regions. The anterior temporal source is consistent with previous intracranial recordings. The right IFG source may explain the asymmetrical pattern frequently observed in magnetic field maps of the N400 response.

E34

MASKED ORTHOGRAPHIC AND PHONOLOGICAL PRIMING IN FMRI Marianna Eddy[1], Jonathan Grainger[2], Phillip Holcomb[3], Stephanie Del Tufo[4], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]CNRS and Aix-Marseille University, [3]Tufts University, [4]Haskins Laboratories and University of Connecticut — Previous studies have shown that visual word recognition involves activation of not only orthographic representations, but also phonological representations. Word recognition that relies on orthographic representations is thought to access semantic information through a direct route that involves coarse-grained orthographic processing, whereas phonologically based word recognition relies more on fine-grained orthographic processing. In the current study, we used masked repetition priming and fMRI to examine brain areas involved in phonological and orthographic processing during visual word recognition. We manipulated the prime-target relationship to either overlap in phonology using pseudohomophone (PH) primes (brane-BRAIN) or orthography using transposed letter (TL) primes (barin-BRAIN). Priming effects for each of these conditions was in comparison to control conditions. For the PH priming condition, we observed repetition suppression in bilateral superior temporal gyri, left pre/postcentral gyri, and left middle occipital gyrus, whereas the TL priming produced repetition suppression in the left inferior frontal gyrus and left occipito-temporal cortex (visual word form area - VWFA). In addition to the priming paradigm, we localized a region of interest (ROI) for each individual, selecting left occipito-temporal clusters that respond more for words than for objects. While only the TL priming condition produced repetition suppression in the VWFA, we found reading ability, specifically rapid naming (RAN – letters) and phonemic decoding (TOWRE), was

related to the pattern of PH priming in the functionally localized VWFA across participants. In addition, TL priming was related to the ability to read unfamiliar words as measured by the Word Attack (WRMT).

E35

MEG MASKED PRIMING EVIDENCE FOR EARLY FORM-BASED DECOMPOSITION OF IRREGULAR PAST TENSE VERBS Joseph Fruchter[1], Linnaea Stockall[2], Alec Marantz[1]; [1]New York University, [2]Queen Mary University of London — To what extent does morphological structure play a role in early processing of visually presented English past tense verbs? Previous masked priming studies have demonstrated effects of obligatory form-based decomposition for genuinely affixed words (teacher-TEACH) and pseudo-affixed words (corner-CORN), but not for orthographic controls (brothel-BROTH; Rastle, Davis, & New 2004). Additionally, MEG single word reading studies have demonstrated that the transition probability from stem to affix modulates an early evoked response called the M170 (Solomyak & Marantz, 2010 and Lewis, Solomyak, & Marantz, 2011, for parallel findings for pseudo-affixed words). Here, utilizing the M170 as a neural index of visual form-based morphological decomposition, we ask whether the M170 demonstrates masked priming effects for regular and irregular past tense verbs (following Crepaldi et al., 2010, who obtained behavioral masked priming results for irregulars). Dual mechanism theories (Pinker & Prince, 1988) predict a rule-based decomposition for regulars but not for irregulars, while single mechanism theories (Stockall & Marantz, 2006) predict the same decomposition for both. MEG data was recorded for 16 subjects performing a visual masked priming lexical decision task. We obtained cortically-constrained minimum norm estimates via FreeSurfer and MNE. Using predefined anatomical regions of interest (ROIs), we found that activity in the left fusiform ROI was modulated by the masked priming manipulation for both regular and irregular verbs, during the time window of the M170. The results support a single mechanism account of the English past tense, in which even irregulars are decomposed into stems and affixes, prior to lexical access.

E36

USING ELECTROPHYSIOLOGICAL MEASURES TO STUDY LEXICALITY JUDGMENTS Ruth Ann Atchley[1], Nancy Azevedo[2], Jonathan Schuster[1], Eva Kehayia[2]; [1]University of Kansas, [2]McGill University — The current electrophysiology (ERP) research demonstrates a novel utilization of the classic oddball ERP task in order to measure task mediated selective attention (as reflected by the P3 ERP component) and morpho syntactic analysis (as reflect by the Left Anterior Negativity, LAN) during lexicality judgments. Testing blocks consist of targets and distractors from distinct lexical categories (i.e. looking for rare Nonwords or pronounceable Pseudowords (20%) presented among Words and also looking for rare Words among Nonwords or pronounceable Pseudowords.) In the two blocks comparing Words and Nonwords, we found robust and statistically reliable P3 and LAN components (p's <.01). Likewise, when participants were asked to detect Word targets when these were imbedded with pronounceable Pseudoword distractors (GLORB), we also saw a reliable P3 and LAN (p's <.01), though the duration of these components were longer in time, which likely reflects greater variability in the time it took participants to make this more challenging lexical decision. In stark contrast, we did not find a P3 or LAN component when Pseudowords were the targets among frequent Words, suggesting that the Pseudowords were word-like enough to avoid obvious detection, and that the presence of many legal words interfered with morpho syntactic analysis. These findings suggest that this novel utilization of ERPs for the study of lexicality judgments in a modified lexical decision task has experimental utility and is a reliable method for detecting subtle aspects of lexicality.

E37

ELECTROCORTICAL MARKERS OF PHONOLOGICAL UNDERSPECIFICATION IN THE MENTAL LEXICON: ERPS TO AN AUDITORY LEXICAL DECISION TASK Noriko Tanigawa[1], Ramin Rahni[1], Matthew Moore[1], John J. Kim[1], Mark W. Geisler[1]; [1]San Francisco State University — The present study utilizes electrophysiological measures to characterize the storage and processing of predictable abstract information about speech sounds in the mental lexicon. Past studies investigated this question by contrasting the processing of coronals (/n /, /d/) that have alternating surface forms (e.g., /n/ pronounced as [n] in rain, [m] in rainbow) with that of non-coronals (/m/, /b/) that do not. Following Friedrich et al.'s (2006) auditory lexical decision paradigm, monomorphemic English nouns were selected that had a uniqueness point with a coronal or non-coronal as the first phoneme of the second syllable. A pseudoword was created from each real word by switching the place of articulation between coronal and non-coronal (e.g., picnic to *picmic; helmet to *helnet). If the coronal feature is not represented in the mental lexicon, processing place-manipulated inputs will result in mismatch for non-coronals (*helnet) but in no-mismatch for coronals (*picmic) (Lahiri, 1999). Event-related potentials (n = 24) were time-locked to preceding phoneme's offset. Predicted asymmetric pseudoword effects emerged in component-specific manners. P2 amplitude was maximal for the specified match (non-coronal real), suggesting target-focused feature processing (Luck and Hillyard, 1994). N400 amplitude was maximally negative for mismatches (non-coronal pseudo onsets) and frontally distributed, suggesting alliterative processing (Praamstra et al., 1993). The posterior P3 indexing lexical-decision making followed the N400 (Polich, 1985). Centroid latency was longer for pseudowords than for real words, demarcating this surface-form processing for uniform lexical-decision from the earlier abstract phonological processing. The early electrocortical asymmetries occurring before task-related processing begins support feature underspecification.

E38

FREQUENCY AND DURATION EFFECTS IN MASKED REPETITION PRIMING Priya Mitra[1], Marianna Eddy[2], Jonathan Grainger[3], Phillip Holcomb[1]; [1]Tufts University, [2]Massachusetts Institute of Technology, [3]CNRS and Aix-Marseille University — Event-related potential (ERP) masked priming paradigms have demonstrated that automatic word processing is sensitive to word frequency in ways that cannot be fully elucidated by behavioral measures. The present study expands upon the effect frequency has on sublexical (N250) and lexico-semantic (N400) stages of word recognition by manipulating both word frequency and prime duration. ERPs were recorded in a forward- and backward-masked repetition priming paradigm with 53, 80, and 107 ms primes and a constant SOA of 120 ms. The influence of word frequency on ERP repetition priming interacted with prime duration in both the N250 and N400 time windows. Previous work suggests that only low-frequency words should elicit an N250 priming effect when stimulus pairs are presented with a long SOA, yet here the effect was seen in both frequency conditions when longer prime durations were introduced to the design. However, in keeping with previous findings, the low-frequency condition seemed to elicit more robust N250 priming effects across prime durations. As expected, both high- and low-frequency words elicited N400 priming effects, but these effects were larger across prime durations for high-frequency words. Combined with previous research, these findings suggest high-frequency priming effects are most sensitive to prime duration and ISI in the N250 time window, where these factors influence whether the prime and target processing will be integrated or processed as distinct perceptual events. In the N400 time window, the more sustained activations of semantic representations are affected more by prime duration in the less efficiently processed low-frequency words.

E40

ERP EVIDENCE FOR DISTINGUISHING BETWEEN ORTHOGRAPHIC/ PHONOLOGICAL AND BALANCED ADULT ENGLISH READERS Valerie Karuzis[1], Joseph Dien[1], Melody Berens[1], Polly O'Rourke[1], Henk Haarmann[1]; [1]University of Maryland - College Park — An ongoing issue in developmental and adult language acquisition is the nature of individual reading style differences. One proposal (Baron & Strawson, 1976) is that adult readers can be divided into those relying more on phonology ("Phoenicians") or on orthography ("Chinese"). A more recent proposal is that dyslexics can be divided into those suffering deficits in phonology or orthography (Castles & Coltheart, 1993). These proposals are plausible under either a dual-route or triangle model approach, but have subjected to debate. A view not yet explored is the existence of a population relying on both processes in a balanced manner ("Phoenese") that has a greater need to integrate divergent outputs from orthography and phonology. In this experiment, we test the proposal (Dien et al., 2008; Dien, 2009) that the Recognition Potential indexes such a mechanism. Participants (n=28) read sentences, presented wordwise, that favored orthographic processing (letter transpositions), phonological processing (pseudo-homophones), or both (normal). They then indicated which of two probe words appeared in each sentence. Accuracy rates were not significantly different between orthographic and phonological conditions (82% versus 80%). The Recognition Potential was significantly greater for the "Phoenese" (quadratic trend between orthography-phonology accuracy and Recognition Potential amplitude, p=0.0455). These results help illuminate how orthographic and phonological systems work together in the reading process, suggest the analysis of three reader groups ("Chinese", "Phoenese", and "Phoenicians") for reading style studies, and propose that an additional cognitive skill potentially present for the "Phoenese" readers could serve as a target for remediation of reading deficits.

LANGUAGE: Other

E41

THE IMPORTANCE OF SUSTAINED FIELDS FOR CORTICAL SPEECH PROCESSING IN TONAL LANGUAGES Christina Fan[1], Xingyu Zhu[1], Hans-Günther Dosch[1], Christiane von Stutterheim[1], André Rupp[1]; [1]University of Heidelberg, Germany — In tonal languages such as Chinese, pitch contours of syllables discriminate lexical meaning at a systematic level, which is not the case for non-tonal languages such as German. It is still unclear how such cross-linguistic differences are reflected at the cortical level. We used 16 natural speech stimuli to investigate the neuromagnetic sustained field (SF) in the auditory cortex of 20 Chinese and 20 German speakers. Stimuli consisted of vowels (being or not being part of Chinese) and syllables (meaningful or meaningless Chinese words). The SF of all stimuli was found to be twice as big for the Chinese as compared to the German subjects. Furthermore, the Chinese group showed larger SF for meaningful syllables compared to meaningless syllables in Chinese in contradistinction to the German group. There were no significant SF differences evoked by vowels whether occurring or not occurring in Chinese. This could be an indicator for the importance of pitch over vowel quality for the generators of sustained field. In a second experiment we observed group-specific differences evoked by linguistic and musical stimuli (French horn). While both stimulus types elicited no significant SF differences for the Chinese, the SF differed for the German group. The horn tone evoked comparable SF in both groups, the linguistic stimulus however elicited significantly smaller signals in the German group. These cross-linguistic results suggest that the SF reflects an important process involved in lexical processing at the level of the auditory cortex.

E42

PROCESSING STATISTICS IN NATURAL COMPLEX SOUNDS: SPECIALIZED SPEECH PROCESSES IN GENERAL AUDITORY AREAS Pascale Tremblay[1,2], Uri Hasson[3]; [1]Université Laval, Département de réadaptation, [2]Centre de Recherche Université Laval Robert-Giffard, [3]Center for Mind & Brain Sciences, Università Degli Studi di Trento — A fundamental yet poorly understood property of the speech signal is its sophisticated sequential organization. Indeed, the speech units (syllables, words) are ordered in time according to complex language-specific constraints, and manifested in language-specific statistics, such as syllable transition probabilities (TP). Specifically, syllables with high TP tend to form words whereas those with lower TPs mark word boundaries. Behavioral studies have shown that children and adults are sensitive to TP; however, very little is known about the neurocognitive processes underlying statistical information processing (SIP) – in particular, it is unclear if statistics are computed through domain-general or speech-specialized mechanisms. The limited available data suggests that the supratemporal cortex (STC) is involved in SIP. In the present study, 20 participants were exposed to auditory speech (syllables) and non-speech (bird chirps) sequences while performing an unrelated visual task. The sequences ranged from random to highly predictable in three levels (random, semi-predictable, highly predictable) according to the TP structure of their elements. Neuroimaging data were acquired using a 4T MRI scanner and focused on a set of bilateral regions-of-interest covering the entire STC. Trend analyses characterized the sensitivity of each ROI to the degree of predictability within speech and non-speech sequences. Results show that while several parts of STC are sensitive to TP in speech and non-speech sequences, mid-predictability sequences were associated with the highest activity for speech sequences, but lowest activity for non-speech sequences, suggesting domain-sensitive SI mechanisms within general auditory processing areas.

E43

DO WE USE CONCEPTUAL OR PHONOLOGICAL REPRESENTATIONS FOR ERROR DETECTION IN SPEECH? Els Severens[1], Ilse Tydgat[1], Martin Pickering[2], Robert J Hartsuiker[1]; [1]Department of experimental Psychology, Ghent University, [2]Department of Psychology, University of Edinburgh — To detect speech errors, internal speech is compared to intended speech (Levelt, Roelofs, & Meyers, 1999). However it is unclear whether a conceptual or phonological representation is used to make this comparison. To investigate this issue, spontaneous speech errors (semantic and phonological) were elicited with a picture-naming task in participants' second language, while event-related potentials (ERPs) were measured. We compared error trials (e.g., saying "appl….melon" to a picture of a melon) with two types of control trials, namely with (a) 'same picture controls', i.e. correct responses to the same picture (e.g. saying "melon" to melon), and (b) 'same initial response', i.e. trials with the same initial response but in which this initial response was correct (e.g. saying "apple" to a picture of an apple). In stimulus-locked averages, there was a negative deflection of semantic errors compared to both control trials in the 600-700 ms time-window. Mixed errors elicited a (smaller) negative deflection compared to controls in the 700-750 ms time-window. When comparing phonological errors with controls, there was no negative deflection. Therefore we conclude that it is easier to detect semantic than phonological errors. Specifically we propose that the monitor uses phonological rather than conceptual information when comparing internal to intended speech. Error detection is harder when two word forms are very similar (i.e. phonological errors), but is easier when two word forms clearly differ, even when the conceptual representations are very similar (i.e. semantic errors). Levelt, Roelofs, & Meyer (1999). Behavioral and Brain Sciences, 22(1), 1-75

E44

COMPARING DIFFERENT NEURAL MARKERS OF DEVELOPMENTAL DYSLEXIA AND READING ABILITY Cheng Wang[1], Joonkoo Park[2], Agnieszka J. Jasinska[1], Joanne F. Carlisle[1], Holly K. Craig[1], Jing Liu[1], Frederick

J. Morrison[1], Stephanie L. Hensel[1], Robert C. Welsh[1], Thad A. Polk[1]; [1]University of Michigan, [2]Center for Cognitive Neuroscience, Duke University — Previous neuroimaging studies have identified a number of neural markers that predict dyslexia and reading ability, but these markers have not been systematically compared in the same subjects. We recruited 48 participants (aged 16-32 years, with mean of 21.7 years) with a wide range of reading abilities (from dyslexics to very good readers) and used structural and functional MRI as well as diffusion tensor imaging to measure a variety of neural markers that have previously been shown to predict reading ability and dyslexia. We then assessed how the neural markers predicted diagnosis (dyslexic or not dyslexic) and reading ability as assessed by the Woodcock-Johnson III Reading Inventory (WJ-III) and the Test of Word Reading Efficiency (TOWRE). Simple correlation and multiple regression results indicated that structural markers were better predictors of reading performance and diagnosis than were functional markers. In particular, asymmetry in the size of the planum temporale and gray matter volume in the right pars triangularis were the best predictors of both reading ability and diagnosis, and integrity of the white matter underlying temporo-parietal cortex was also a good predictor of diagnosis. Supported by NIH grant R21HD064983 to T.A.P.

E45

FUNCTIONAL INTEGRATION CHANGES IN SECOND LANGUAGE LEARNING OF A DISTANT LANGUAGE Ladan Ghazi Saidi[1,2,4], Vincent Perlbarg[3,4], Guillaume Marrelec[1,3,4], Mélani Pélégrini-Issac,[3,4], Habib Benali[3,4], Ana-Inés Ansaldo[1,2,4]; [1]Centre de Recherche Institute Gériatrie de Montreal, Montreal, Quebec, Canada, [2]Université de Montréal, Montréal, Canada, [3]Inserm et UPMC Univ Paris 06, UMR-S 678, Laboratoire d'Imagerie Fonctionnelle, Paris, France, [4]Université de Montréal, Inserm et UPMC Univ Paris 06, LINeM, Laboratoire International de Neuroimagerie et Modélisation, Montréal, Canada — We report the learning related changes in functional connectivity observed in a group of Persian (L1) native speakers (N= 12) who were enrolled in an intensive computerized French lexical-training program, Participants were tested on a picture-naming task with cognates, noncognates and clangs, administered during fMRI scanning before and after consolidation of L2 lexical learning. Changes in functional connectivity were characterised at the level of functional Integration (I), which provides a measure of the global cohesion of a network (Marellec, 2008) Specifically we focused on the L1 and L2 language processing networks and the control system (e.g. working memory and cognitive control areas) as defined by previous literature (Price 2010; Green & Abutalebi, 2007), and in our recent fMRI study on the same cohort (Ghazi Saidi & Ansaldo, in preparation). In particular, measures of total, within-network and between-network (I) (Marcellec, et al., 2008) were calculated with NetBrainWork (Perlbarg, 2009). The results show no changes in (I) across learning phases for L1, whereas for L2 the total, inter and intra-network (I) decreased, significantly with proficiency improvement. In line with the literature (Majerus, et al., 2008; Prat, et al., 2007; Dodel, et al., 2005), this evidence shows that low proficiency in L2 is associated to enhanced functional connectivity between and within the L1 and L2 language networks and the control system . Further, with proficiency increase, and decreased processing demands, there is a significant reduction of total, within and between language networks (I) decreases. (242 words) References: Abutalebi, J., and Green, D., (2007), Bilingual language production: The neurocognition of language representation and control, Journal of Neurolinguistics, 20, (3), 242-275. Dodel, S., Golestani, N., Pallier, C., ElKouby, V., Le Bihan,D., Poline, J. (2005), Condition-Dependent Functional Connectivity: Syntax Networks in Bilinguals, Philosophical Transactions: Biological Sciences, 360, 1457, pp.921-935 Ghazi Saidi & Ansaldo, in preparation, Majerus S, Belayachi S, De Smedt B, Leclercq AL, Martinez T, Schmidt C, Weekes B, Maquet P. (2008), Neural networks for short-term memory for order differentiate high and low proficiency bilinguals, Neuroimage, 42 (4), pp. 1698-713. Marrelec, G., Bellec, P., Krainik, A., Duffau, H., Pe´le´grini-Issac, M., Lehe´ricy, S., Benali, H., Doyon, J., (2008), Regions, systems, and the brain: Hierarchical measures of functional integration in fMRI, Medical Image Analysis, 12, 484–496. Perlbarg, V., Marrelec; G., Bellec; P., Coynel, D., Pélégrini-Issac, M., Benali, H., (2009), NetBrainWork: a toolbox for studying functional interactions in large-scale brain networks in fMRI. In Proceedings of the 15th International Conference on Functional Mapping of the Human Brain, San Francisco, Californie, USA. Prat, C. S., Keller, T. A., Just, M. A., (2007), Individual differences in sentence comprehension: a functional magnetic resonance imaging investigation of syntactic and lexical processing demands, J Cogn Neurosci, 19 (12), pp. 1950-63. Price, C., (2010), The anatomy of language: a review of 100 fMRI studies, Annals Of The New York Academy Of Sciences, Issue: The Year in Cognitive Neuroscience

E46

PROCESSING INTRA-SENTENTIAL AND INTER-SENTENTIAL CODE SWITCHES IN COMPREHENSION: AN FMRI STUDY Gangyi Feng[1], Suiping Wang[1], Hsuan-Chih Chen[2]; [1]South China Normal University, [2]Chinese University of Hong Kong — Although proficient bilinguals are capable of switching from one language to another without much apparent difficulty in daily language comprehension, previous studies have shown that switching between languages activates several extra brain regions related to cognitive control. However, it is unclear whether processing code switches at different levels of linguistic structure involves the same neural substrates. Using the event-related fMRI technique, the current study investigated the neural correlates of two kinds of code switching effects (i.e., intra- and inter-sentential) during narrative reading. Inter-sentential switching refers to a language switch between two successive sentences, while intra-sentential switching refers to a switch occurred on a specific word (always a noun) in the middle of a sentence. Forty Chinese-English bilinguals read a story containing the two types of code switches for comprehension. Consistent with previous studies, our results showed that switching between two languages activated an extensive network, including bilateral prefrontal, temporal and subcortical regions. More importantly, we found that processing intra- and inter-sentential switches produced different patterns of brain activation. Specifically, intra-sentential switches evoked increased BOLD signal changes in several brain regions in the "control network" and "language network", including bilateral dorsal prefrontal cortex, inferior frontal gyrus, middle temple gyrus, anterior cingulate cortex, inferior parietal cortex, and precuneus/posterior cingulate cortex. In contrast, inter-sentential switches activated a language related network, including bilateral frontal and temporal regions. These results suggest that recognizing and/or unifying two linguistic codes at different levels of linguistic structure may involve different language selection mechanisms.

E47

ABNORMAL CORTICAL DISTRIBUTION IN RELATION TO NAMING DEFICITS IN MALES WITH ISOLATED CLEFT OF THE LIP AND/OR PALATE Ian DeVolder[1], Lynn Richman[1], Amy Conrad[1], Vince Magnotta[1], Peg Nopoulos[1]; [1]University of Iowa — Previous research has shown structural differences within brains of males with isolated cleft lip and/or palate (ICLP), along with deficits in naming. It has also been established that the primary sub-types of ICLP, cleft lip with/without cleft palate (CL/P) and cleft palate alone (CPO), are etiologically distinct. The current study aims to find unique neuroanatomical differences between cleft sub-types and to connect these structural abnormalities with the naming deficits seen in this population. Male subjects aging from 7 to 17 years participated; 55 were healthy controls, 45 had ICLP (34 CL/P; 11 CPO). Scores on the Boston Naming Test (BNT) and the Rapid Automatized Naming (RAN) Tests were collected from all participants. Measures of total cerebral volume and cerebral lobe volumes were also obtained via MRI. These measures were compared between controls and the two cleft subtypes. After controlling for verbal ability both cleft groups showed naming deficits. The tissue distribution within the cerebrum was uniquely abnormal for each cleft sub-type: CL/P males showed enlargement of the temporal lobes, while CPO males showed reduction in the parietal lobes. For CL/P, temporal lobe enlargement did not correlate with naming deficits. However, in CPO, smaller parietal lobes significantly corre-

lated with worse performance on the BNT (r = .786) and the RAN (r = .913). This structure/function association was absent in controls. The results indicate atypical cerebral morphologies that are dependent on cleft sub-type in males. For CPO, this abnormal tissue distribution appears to be pathologic and directly correlated with poorer naming abilities.

E48

GRAMMATICAL ASPECT MODULATING ONLINE COSTS OF LONG-DISTANCE DEPENDENCY PROCESSING: NEUROPSYCHOLOGICAL EVIDENCE Martin Paczynski[1], Gina Kuperberg[1,2]; [1]Tufts University, [2]Department of Psychiatry, Massachusetts General Hospital — Grammatical aspect can significantly impact several components of language processing, including how quickly information decays within working memory. In the current study we used Event-Related Potentials (ERPs) to investigate the effect of grammatical aspect on the processing of long-distance dependencies (LDDs). We fully crossed grammatical aspect of the sentence initial verb (perfective "Mary wondered…"; imperfective "Mary was wondering…") with the presence ("…who the businessman…") or absence ("…whether the businessman …") of a LDD. ERPs were recorded to the embedded verb ("fired"). We found a significant interaction between grammatical aspect and LDD throughout the recording epoch. Embedded verbs in the perfective condition evoked a greater anterior negativity within the N100, 400-600ms, and P600 time windows in the LDD condition compared to the non-LDD condition, consistent with previous literature. ERPs evoked by embedded verbs in the imperfective condition failed to evoke these early anterior negativities, instead evoking a robust, broadly distributed P600. Our results demonstrate that grammatical aspect significantly impacts online sentence processing. Specifically, it appears to attenuate early costs of long-distance dependency processing, instead inducing later processing costs which may be associated with the release of information from working-memory.

E49

NEURAL BASES OF METALINGUISTIC AWARENESS AND EARLY READING ACQUISITION: MOVING BEYOND PHONOLOGICAL PROCESSING. Maria M. Arredondo[1], Kira Mascho[1], Alyssa Mastic[1], Ka I. Ip[1], Lucy Shih-Ju Hsu[1], Sarah Spath[1], Neelima Wagley[1], Stefanie Younce[1], Kathryn Wardin[1], Lisa Thierbach[1], Ioulia Kovelman[1]; [1]University of Michigan — Different types of language knowledge are thought to be critical for reading acquisition in children. Currently, the field has placed an overwhelming emphasis on Phonological Awareness: The ability to manipulate the phonological units of language. Yet, research shows that while Phonological Awareness is necessary, it is "not sufficient for learning to read in English" (Berninger et al., 2010). Other types of language awareness, especially Morphological Awareness which is the ability to manipulate the morphemes of language, are found to be equally as important for learning to read in English and in other languages. Unfortunately, unlike Phonological Awareness, relatively little is known about the learning and brain bases of Morphological Awareness. QUESTION. What are the neural bases of Morphological Awareness in elementary school children? METHOD. Young English speakers (mean age 8, n = 10) completed comparable auditory Morphological and Phonological Awareness tasks and a control word-matching task in the fMRI. Children also completed language/literacy assessments. RESULTS. Children showed greater activation in left inferior and middle frontal gyri in response to the Morphological relative to the Phonological Awareness task. CONCLUSION. Morphological Awareness ability is thought to integrate complex phonological, semantic, and morphosyntactic knowledge—It also takes longer to develop compared to Phonological Awareness. Our findings suggest that the protracted developmental growth of Morphological Awareness might rely on the maturation of the left frontal lobe. The results offer new insight into the neural as well as learning processes at the root of reading acquisition and carry implications for understanding language impairments and dyslexia.

E50

LONGITUDINAL CHANGE IN MMN AND N400 RESPONSES TO ARABIC LINGUISTIC FEATURES (OR TO ARABIC PHONEMIC CONTRASTS, LEXICAL STATUS, AND MORPHOLOGICAL PATTERNS) BY A HERITAGE AND NON-HERITAGE LEARNER OF ARABIC Reem Khamis-Dakwar[1], Karen Froud[2]; [1]Adelphi University, [2]Teachers College, Columbia University — To investigate the role of prior exposure in adult L2 acquisition, we examine neural correlates of phonological, lexical, and morphological learning of L2 Arabic in one heritage learner (P1) and one non-heritage learner (P2). Both learners participated weekly in a series of EEG experiments during a 5 week Arabic program, including: 1) MMN elicitation in response to Arabic consonant contrasts; 2) lexical decision to written Arabic real and pseudowords; 3) a morphology processing task, requiring identification of morphological relatedness between written Arabic word pairs sharing weak or strong root connections, compared to unrelated words. In the MMN paradigm, latency differences were observed. For P1, MMN was observed at 100-200 ms from week 1, whereas P2 showed a later negativity (200-300 ms) from week 3. In the lexical decision experiment, P1 showed an N400 response from week 2. P2 showed signs of an N400 response from week 1, but in week 4 a P600 response was apparent. In the morphology experiment, P1 showed an N400 response to unrelated word pairs and a positivity in the same time window in response to weak root connections, from week 1. For P2, N400 was observed in response to unrelated and weak root pairs only from week 5. These variable brain responses show similarities with previous studies examining ERP correlates of L2 grammatical learning in adulthood (e.g., McLoughlin, Tanner et al., 2010) and suggests rapid and continued reorganization in language processing networks as a response to L2 exposure, even in circumstances of prior exposure.

LANGUAGE: Semantic

E51

INDEPENDENCE OF PRAGMATIC AND LEXICO-SEMANTIC PROCESSING IN PICTURE-SENTENCE VERIFICATION Stephen Politzer-Ahles[1], Xiaoming Jiang[2], Robert Fiorentino[1], Xiaolin Zhou[2]; [1]University of Kansas, [2]Peking University — Examining the processing of sentences with quantifiers like "some" provides an ideal test case for elucidating the neurocognitive foundations of semantic and pragmatic meaning composition. In sentences like "Some of the students are hard-working", "some" contains two possible meanings: "at least one" (the inherent, logical meaning) and "not all" (the pragmatic meaning, generated through an enrichment process that may be context-dependent). Our previous event-related potential research in Mandarin suggests that pragmatic enrichment of the meaning of "some" occurs rapidly, and is subsequently inhibited when inconsistent with the context. An open question is how reanalysis of the pragmatic meaning affects processing downstream. In the present study, we showed participants pictures in which several characters are interacting with either the same kinds of objects or different objects. These were followed by correct sentences, sentences in which the object did not match the objects shown in the picture, sentences in which the quantifier was pragmatically inconsistent with the context (i.e., "some" after a picture where all characters are doing the same thing), or sentences in which both the object mismatched and the quantifier was inconsistent. Cluster-based permutation statistics indicated that object (lexico-semantic) mismatch elicited a classical N400 effect, pragmatic inconsistency elicited a late negativity on the downstream object, and semantic and pragmatic inconsistency did not interact. Effects at the quantifier position replicated our previous findings. These results suggest that, although the pragmatic meaning of the quantifier is computed rapidly, reanalyzing the pragmatic meaning does not impede lexico-semantic processing; instead, they unfold in parallel.

E52

NOUN ANIMACY AND VERBAL TELICITY JOINTLY MODULATE SENTENCE PROCESSING: AN EEG STUDY Evguenia Malaia[1], Sharlene Newman[2]; [1]University of Texas Arlington, [2]Indiana University — The question of how information from semantic and syntactic modules of the linguistic system is integrated is unresolved. In this EEG study we used the semantic features of nouns (animacy) and verbs (telicity) to investigate the timeline of syntax-semantics interface processing. EEG data was recorded while participants read reduced relative clauses (The witness seized by the agent was in danger) with telic and atelic obligatory transitive verbs, followed by a comprehension probe. The animacy of the first argument was also manipulated. Frequency, length, and the co-occurrence probability of target verbs and nouns were matched across conditions. Probe accuracy was high (> 80% correct) for the 13 participants (7 male). Statistical analysis revealed significant effects of argument animacy on the amplitude of the right anterior negativity (N2 component) on the first noun, telicity effects over the central electrode cluster on the first verb, and a telicity x animacy interaction in latency and amplitude of the P3b component over the left posterior electrode cluster on the verb in the matrix clause, with the earliest and least negative deflection for the Animate Telic condition, followed by Animate Atelic, Inanimate Atelic, with Inanimate Telic condition eliciting the latest and most negative P3b component. The results appear to suggest that the cognitive load of thematic role assignment in the RRC is modulated by verb and argument semantics, resulting in a gradient distribution of processing difficulty on the second verb. This is thought to reflect the joint operation of attention and working memory during syntax-semantics integration.

E53

HEMISPHERIC SPECIALIZATION FOR MEANING PROCESSING IN METAPHORS Henk Haarmann[1], Timothy George[1]; [1]University of Maryland College Park — Our study tested whether there is a hemispheric advantage for novel metaphors judgment. Marshal and Faust (2008) used a divided visual paradigm and a signal detection theory (SDT) to address this question and reported a right hemisphere (RH) advantage. Their finding is consistent with the claim that the RH is specialized in integrating unrelated word meanings. Other studies found a left hemisphere (LH) or no hemispheric advantage for this task, but failed to include SDT-based data analysis. To address this discrepancy, we tested sixty-nine right handed university of Maryland students in a divided field paradigm using a SDT-based analysis. Their task was to judge whether a word pair was a novel metaphor or unrelated. The second word in each pair was presented either in the left or right visual field. Participants were grouped into slow and fast responders. Analysis of variance (ANOVA) of sensitivity (d') indicated that there was a LH advantage for novel metaphor judgment in slow (but not fast) responders. In addition, the RH had a more liberal response bias (beta) regardless of processing speed. One interpretation of these results is that when given sufficient time the LH has a better ability to detect the absence of a meaning relation, which could then be used to discriminate between related (novel metaphor) and unrelated word pairs. This interpretation and the additional finding of a more liberal response bias for the RH are consistent with the proposal of greater overlap among word meaning representations in the RH.

E54

NEUROPHYSIOLOGICAL INDICES OF SEMANTIC PROCESSING IN CHILDREN WITH IDDM Joseph Hoffman[1], Reem Khamis-Dakwar[1]; [1]Adelphi University — Individuals with Insulin Dependent Diabetes Mellitus (IDDM) are at increased risk of hypoglycemia which may contribute to long-term neurological dysfunction. Effects of insulin treatment on language processing are not well understood, with behavioral results across the literature suggesting effects on vocabulary, comprehension, verbal memory, and verbal intelligence. Neurophysiological studies in this domain have focused on effects of insulin treatment on attention and learning. To date, no investigations have used EEG to investigate semantic processing in children with IDDM. To evaluate whether poor vocabulary development in children with IDDM is associated with changes in lexico-semantic processing, we investigated the N400 response from ten monolingual English-speaking children (aged 7-12 years); five had received insulin treatment for IDDM for at least 2 years, and five served as controls. The Word Classes subtest of the CELF-4 was used as a behavioral measure of semantic knowledge. Participants were then presented with picture-word pairs that were either congruent (the picture depicted the spoken word) or incongruent (unrelated), and asked to press a button to indicate congruency. ERPs were derived from 32 channel EEG recordings by averaging and montaging to centro-parietal sensors within each condition. N400 was observed upon grand averaging of all participants, and amplitude was greater in response to incongruent word-picture pairs for both control and IDDM groups; however, the amplitude of the N400 was attenuated in the IDDM group. We propose that these preliminary findings reveal differences in lexico-semantic processing in children with IDDM who have received insulin treatment for at least 2 years.

E55

PREDICTIVE NETWORK OF SEMANTIC PROCESSING: A DYNAMIC CAUSAL MODELING STUDY Fahimeh Mamashli[1], Burkhard Maess[1], Jonas Obleser[1], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences — Language processing is usually performed rather effortlessly by humans under normal conditions. However, it is a demanding ability, and it has been demonstrated that high predictability of the upcoming content can significantly ease the understanding. To investigate such a sophisticated interplay between bottom-up and top-down processes we set up an experiment varying high and low semantic predictability in sentences. We hypothesize that top-down processes should be more relevant when processing highly context-restrictive verbs compared to less context-restrictive verbs. Such information transfer direction can be modeled in Dynamic Causal Modeling (DCM) as modulation of extrinsic backward connections. MEG data was recorded from 21 participants listening to the sentences . Evoked fields were computed for the onsets of verbs and nouns and the two conditions. For the verbs and nouns we found significant N400m-like differences between conditions. Evoked fields were then submitted to a DCM analysis. All tested models were based on a set of four brain regions of interest in temporal and frontal areas for each hemisphere; plus a deep source (thalamus). All models were assumed to be hemispherically symmetric. We varied the actual number of connections and whether either forward or backward or both connections accounted for the difference between high and low semantic predictability. Familywise Bayesian model selection demonstrated that deep sources are not important to this network and backward connections (top-down) are favored when explaining the differences due to semantic predictability. We take that as evidence for the relevance of top down processes role in predictive semantic processing.

E56

THE RIGHT HEMISPHERE BREAKS THE RULES: EVENT RELATED POTENTIALS REVEAL STRONGER ENCODING OF ILLEGAL STRINGS IN THE RIGHT HEMISPHERE THAN THE LEFT Danielle Dickson[1], Kara Federmeier[1,2]; [1]University of Illinois at Urbana-Champaign, [2]The Beckman Institute for Advanced Science and Technology — The independent contributions of the right and left hemispheres to visual word recognition were examined using event related potentials (ERPs) in a repetition paradigm with both presentations of items lateralized. Stimuli included words, pronounceable but meaningless pseudowords, meaningful acronyms, and meaningless illegal letter strings to fully examine factors of familiarity and orthographic regularity. There is a strong assumption in the literature that the mapping of orthography to semantics is the domain of left hemisphere (LH). However, first presentation of these items showed similar effects of orthographic neighborhood size across the hemispheres such that there was more activation for orthographically regular items (words, pseudowords) than irregular (acronyms, illegal strings). This

suggests that semantic information is structured similarly in both hemispheres. There is typically a broad reduction in activity for repeated items as a function of the extent to which the item was processed for semantics following first presentation. The current study found that both hemispheres showed repetition effects for words, pseudowords and acronyms, which suggests that the RH, like the LH, processes all potentially meaningful items for semantics, regardless of their orthographic regularity. The RH, but not the LH, had an additional repetition effect for meaningless orthographically illegal strings. This suggests that RH processing of these strings is more extensive than LH, and, more broadly, that downstream processing mechanisms in the hemispheres are critically different. A follow-up study with lateralized first presentation but identical, centralized second presentation further suggests that this effect occurs due to differences at encoding.

E57

A THEORETICAL ACCOUNT OF LEXICAL-SEMANTIC NAMING DEFICITS IN BILINGUAL APHASIA Teresa Gray[1], Swathi Kiran[1]; [1]Boston University — Very little is understood about the neuropsychological deficits in bilingual aphasia. The purpose of this study is to examine the relationship between lexical and semantic processing in bilingual aphasia, to investigate the role of language proficiency, and to develop a model that provides a framework for understanding language impairment patterns subsequent to brain damage. In order to examine pre-morbid language skill and language impairment, 13 Spanish-English bilingual aphasic subjects completed a language use questionnaire and a battery of formal tests specifically designed to evaluate receptive and expressive deficits within the language processing system. We then developed a model of bilingual language processing, using both the Revised Hierarchical Model (Kroll & Stewart, 1994) and the Ellis and Young (1988) model of language processing as supporting schemas. We used our psycholinguistic model of bilingual language processing as a means to frame language deficits in bilingual aphasia. According to our model of bilingual language processing, lexical input is less impaired than lexical output with conceptual knowledge generally preserved across subjects. Our correlations suggest that higher pre-morbid language skills are associated with higher language scores after brain injury. By utilizing a psycholinguistic approach to analyze neuropsychological deficits in bilingual aphasia, we are able to produce a reliable model that represents linguistic processing of bilingual language processing.

E58

EXPLORING FACTORS RELATED TO THE NEURAL BASIS OF METAPHOR Elizabeth Fast[1], Ashley Drew[1], Elizabeth Miller[1], Audrey Weil[1], Gwenda L Schmidt[1]; [1]Hope College — Studies on the neural basis of metaphor comprehension have produced inconsistent results due to poorly controlled stimulus sets, and have not often considered the lexical class of the metaphorically used word or the explicitness of the concept expressed. Previous research has primarily focused on metaphors that are nominal (noun-based) and explicit (stating a clear metaphorical comparison or mapping). Because nouns and verbs possess different neural substrates, nominal and predicate metaphors may be processed distinctly. Some research has been conducted on predicate (verb-based) metaphors but these metaphors are implicit (the comparison or mapping is not directly stated). We used a highly controlled stimulus set in an event related potential (ERP) study to observe the neural uniqueness of metaphor comprehension (n=18). Experimental stimuli were nominal explicit metaphors (The unexpected divorce was an earthquake) nominal implicit metaphors (The relationship could not withstand the earthquake) and implicit predicate metaphors (Over the canvas the paint danced). Matched literal and anomalous sentences served as controls. The N400 amplitude was larger for metaphors than literal sentences in both the nominal and predicate conditions. Implicit and explicit nominal metaphors had a marginally significant difference in their N400 amplitude scalp distributions. Because the stimulus set was controlled on many factors, including sentence familiarity, naturalness and imageability, the findings support unique neural mechanisms for metaphor processing, but not based on lexical class. It may also be that the explicitness of a metaphoric statement modulates its neural instantiation.

E59

RECRUITMENT OF SEMANTIC NETWORKS FOR SUCCESSFUL OVERT WORD READING IN CHRONIC APHASIA Sara T. Berentsen[1,2], William W. Graves[1], Michael Seidenberg[2], Jeffrey R. Binder[1]; [1]Medical College of Wisconsin, [2]Rosalind Franklin University of Medicine and Science — Damage to perisylvian structures in the left middle cerebral artery territory typically causes phonological processing deficits, typified by phonological paraphasias and inability to sound out pseudowords. The mechanisms supporting successful overt word reading in the setting of chronic left perisylvian phonological system damage are unclear. We hypothesized that patients recruit undamaged parts of the semantic system to mediate successful word reading. Event-related fMRI was used to study 24 chronic aphasia patients as they read aloud 72 each of concrete nouns and matched pseudowords (pronounceable nonwords). Activation maps for correct and incorrect responses to words and pseudowords were compared. In separate behavioral testing, patients performed an overt reading task and a pseudoword rhyme judgment task to characterize reading ability and phonological deficits. In behavioral tests outside the scanner, patients showed a pattern of severe phonological impairment, as demonstrated by a high incidence of phonological paraphasia (56% of errors on average) in the reading task and severe impairment on the pseudoword rhyme judgment task (average z-score = -5.26). Successful compared to unsuccessful word reading activated the angular gyrus (AG) and posterior cingulate/precuneus bilaterally. Successful compared to unsuccessful pseudoword reading activated the right AG. An interaction analysis showed that recruitment of the left AG and posterior cingulate/precuneus bilaterally was specific to successful word reading. In previous studies, the AG and posterior cingulate cortex have been strongly linked with semantic processing. Here we show that undamaged regions of the semantic network support successful word reading after damage to the left perisylvian phonological network.

E60

ERP INFORMATIVE FINDINGS: DISPREFERRED ADJECTIVE ORDERS ELICIT BRAIN RESPONSES ASSOCIATED WITH LEXICO-SEMANTIC RATHER THAN SYNTACTIC PROCESSIN Hsu-Wen Huang[1], Kara Federmeier[1]; [1]Department of Psychology, University of Illinois at Urbana Champaign — Speakers have strong intuitions about how to sequence series of adjectives that modify a noun. For example, in English the phrase “heavy hardback encyclopedia” sounds natural but “hardback heavy encyclopedia” sounds odd. Linguistic accounts of adjective ordering preferences have postulated a number of grammatical/semantic factors (e.g. informativeness, definiteness, etc) that may play a role in determining how adjectives are sequenced. One additional factor that has not been widely considered is the concreteness of the adjectives being combined. The current study examined this question by systematically crossing order preference and concreteness in phrases consisting of two adjectives and a noun. Thus, we used phrases like those in prior studies in which the preferred order has a concrete adjective second (“exhaustive hardback encyclopedia”), but also phrases in which the preferred order has a more concrete first adjective (“heavy informative encyclopedia“). We find that concreteness-related modulations of the ERP waveform were likely responsible for prior reports of increased positivity to dispreferred orders (interpreted as a P600 -- and thus syntactic -- effect). When concreteness is controlled, instead, we find that dispreferred orders are associated with increased N400s to the second adjective and following noun. This suggests that the processing of adjectives in dispreferred orders impacts lexico-semantic predictability and the ability to generate mental images of the referent but does not elicit brain responses associated with syntactic processing difficulties.

LONG-TERM MEMORY: Episodic

E61

THE INFLUENCE OF UNITIZATION ENCODING ON THE NEURAL CORRELATES OF ASSOCIATIVE RECOGNITION: EVIDENCE FROM FUNCTIONAL MAGNETIC RESONANCE IMAGING Regine Bader[1], Axel Mecklinger[1], Bertram Opitz[1], Wolfgang Reith[2]; [1]Saarland University, Saarbrücken, Germany, [2]Saarland University Hospital, Homburg/Saar, Germany — Remembering arbitrary associations generally requires recollection, an effortful process controlled by the extended hippocampal system. However, recent research suggests that integration of separate items into a single configuration (unitization) leads to reduced involvement of recollection during associative recognition and greater reliance on familiarity mediated by the perirhinal cortex. In line with this unitization account, recognition of compound words (e.g., motor-cycle) as compared to unrelated word pairs was shown to rely more on the perirhinal cortex and less on the hippocampus. Beyond that, unitization can also be used as encoding strategy by combining unrelated words into a novel concept (vegetable bible = a book consulted by hobby gardeners). This was shown to boost memory performance for patients with hippocampal lesions compared to word pairs studied as parts of a sentence (sentence encoding). Employing this paradigm in a functional magnetic resonance imaging (fMRI) study, we explored whether newly formed units elicit familiarity signals comparable to items with pre-existing representations. To this end, studied pairs reappeared in the same or in reversed order. After unitization encoding, reversing pairs is assumed to disrupt the unit but leave familiarity for single words intact. As expected, same pairs were recognized faster than reversed pairs after unitization but not after sentence encoding, but we found no familiarity-related modulations for same pairs in the perirhinal cortex. However, compared to sentence encoding, unitization encoding reduced the involvement of the extended hippocampal system at retrieval. This is the first fMRI evidence of a reduction in recollection recruitment after single-trial unitization.

E62

EVENT-RELATED POTENTIALS OF TRUE AND FALSE MEMORY FOR VISUAL OBJECTS Yolanda Higueras[1], Christoph Klein[1], Stephan G Boehm[1]; [1]School of Psychology, Bangor University — One of the most pervasive failures of memory is remembering events that never occurred. A common way of inducing false memories is the Deese-Roediger-McDermott paradigm, in which study lists of words are presented that are semantically or conceptually related to critical 'lure' words; when memory for list words is later tested, the lures are often remembered although they had not been presented. Investigations into the neural underpinnings of false memories with event-related potentials have shown mixed results; some studies found that false memories engage the same memory circuits than veridical memories, whereas others found different patterns of neural activity. Here, we used event-related potentials to investigate whether false and veridical memories engage similar or different neural networks. We engaged participants in a visual task similar to the Deese-Roediger-McDermott paradigm. Participants saw complex images, each of a particular topic (for example, a beach scene); afterwards, memory for individual objects of these scenes was tested by showing old objects from these scenes together with new objects not presented before and lure objects not presented before but fitting one of the topics of the study images. Participants showed good memory for old objects, as well as considerable false memories for lure objects. Event-related potentials for old and lure in relation to new objects showed a central positivity around 300-700 ms, which was larger for old than lure objects. These results indicate that false remembering engages similar neural networks than veridical remembering, although these networks are less active for false than veridical memories.

E63

THE INFLUENCE OF GRADED PERCEPTUAL PREPARATION ON ENCODING-RELATED PRESTIMULUS ACTIVITY Danying Wang[1], Matthias J Gruber[1], Eva M Bauch[1], Leun J Otten[1]; [1]University College London — Brain activity before an event can influence the efficiency with which information is encoded into long-term memory. The functional significance of such activity is largely unknown. In this study, we varied the amount of advance information about a visual event to assess how perceptual preparation affects encoding-related prestimulus activity. Electrical brain activity was recorded from the scalps of 24 healthy adults while they made size judgments about series of objects. Objects were shown in the form of a detailed photograph or perceptually impoverished outline. A cue presented 1.5 s before object onset either gave no advance information about the type of object that would be presented, or signalled the presentation of an outline or photograph. Perceptual preparation was expected to increase the more advance information was available. A surprise recognition test was given one day later to probe memory for the objects. Event-related potentials elicited by cues differed depending on whether objects were later remembered or forgotten. However, this only occurred for photographs. Waveforms preceding later remembered photographs were more positive-going over frontal scalp sites. Time-frequency analyses showed that later remembered photographs were also preceded by a decrease in power in the theta frequency band (4-8 Hz) over posterior sites. Prestimulus theta activity also differed when the cue was not informative. Together, the findings suggest that encoding-related activity before an event is influenced by degree of perceptual preparation. The more perceptual details are available to guide preparation, the more likely it is that prestimulus activity influences encoding.

E64

RECOLLECTION AND FAMILIARITY SUM TOGETHER: EVIDENCE FROM ERP Adam Dede[1], Jason Arndt[1]; [1]Middlebury College — Debate surrounds the interaction between familiarity and recollection. Familiarity is the process responsible for item memory in the absence of detail. Recollection is the process responsible for memory of source details. Two prevailing theories are that recognition is either a result of summed input from these two processes (additive) or each recognition decision may reflect information from only one process or the other (process pure). Many studies comparing these views have not properly considered the confounding effects of memory strength between recollection and familiarity. In a word-memory study we collected both fine-grained confidence ratings (100-point scale) and source judgments (i.e. which of 4 voices had spoken the word at study). Additionally, ERPs were collected. By matching the confidence of items with source-detail correct and source-detail incorrect we examined the independent ERP effects of source memory and memory strength. Results showed that the p600, an ERP component previously thought to represent recollection, was sensitive to both source memory and memory strength for old items. Specifically, strong source hits and strong misses both showed p600 activation. Although both item types were different from correct rejections, strong source hits showed greater activation than strong source misses. However, the p600 was insensitive to source memory when item memory was weak. Combined, these results indicated that p600 activation was related to an interaction between source memory, subserved by recollection, and memory strength in the absence of source memory, subserved by familiarity. Thus, the results support the additive view of familiarity and recollection interaction.

E65

PHASE-AMPLITUDE COUPLING DURING ENCODING OF EPISODIC MEMORIES IN THE HUMAN HIPPOCAMPUS Brad Lega[1], Joshua Jacobs[2], John Burke[1], Ashwini Sharan[3], Gordon Baltuch[1], Michael Kahana[1]; [1]University of Pennsylvania, [2]Drexel University, [3]Thomas Jefferson University — Phase-amplitude coupling (PAC) has been demonstrated in the human cortex and hippocampus, but its link to episodic memory has not been established. We examine 237 electrodes from 41 intracranial EEG patients

undergoing invasive pre-surgical monitoring. Participants performed the Free Recall task while iEEG signal was recorded. Using a phase bin method, we identify significant PAC that is strongest in the slow-theta band (2.5-5 Hz) in the hippocampus, while it occurs in the 4-10 Hz theta band in the temporal cortex and 4-8 Hz in the frontal cortex. The strength of PAC (as measured by effect size) is greater during successful encoding (.031 vs. .015, $t(81) = 3.26$, $p<.001$). Using circular regression, we extracted a single phase preference value for each electrode that exhibited significant PAC. We then compared the distribution of preferred phase values across electrodes between successful and unsuccessful memory encoding, identifying no significant difference ($p = 0.33$). Phase preference was concentrated at 180 degrees, as has been previously reported, as well as 50-100 degrees. Electrodes that exhibited 180 degree PAC exhibited a significant increase in gamma band power during successful encoding, while those exhibiting 50-100 degree PAC exhibited a gamma power decrease. This work extends previous effects we have observed during episodic memory encoding. PAC was strongest for slow-theta to high gamma band, consistent with our previous results identifying a power increase in the slow theta band during successful memory formation, as well as data showing a gamma band power increase.

E66

LATERAL POSTERIOR PARIETAL ACTIVITY DURING SOURCE DISCRIMINATION OF MEMORIES OF HIGH AND LOW PERCEPTUAL VIVIDNESS Danielle King[1], Michael Miller[1]; [1]University of California, Santa Barbara — The parietal old/new effect is the consistent finding that regions of the lateral posterior parietal cortex (PPC), and particularly the left lateral PPC, are more active during recognition of previously studied items compared to correct rejection of new items. In a previous study, we demonstrated that this effect is source-specific. Recognition of items that were perceived during encoding elicited a robust, left-lateralized old/new effect. However, for items that were imagined, there was hardly an effect in the left PPC, but there was a small effect in the in right PPC, in a region more anterior to the left hemisphere homologue. It has been suggested that the role of the lateral PPC in recognition memory is to represent the contextual details that pertain to memories of episodic events (Wagner et al., 2005). Because memories from perception have been shown to contain more perceptual contextual details than memories from imagination (Johnson et al., 1993), these results suggest that the left PPC specifically represents perceptually based contextual details of episodic memories. In the present study, we tested this hypothesis directly by using fMRI to compare brain activity during a task that required subjects to decide the source of perceived and imagined events, which were encoded in either a high perceptual vividness or low perceptual vividness condition. The results speak to the nature of the role of the lateral PPC in recognition memory.

E67

RECOGNITION MEMORY PERFORMANCES IS AFFECTED BY TRANSCRANIAL DIRECT CURRENT STIMULATIONS OVER THE LEFT POSTERIOR PARIETAL CORTEX Nai-Feng Chen[1], Chi-Hung Juan[1], Daisy L. Hung[1], Ovid J. -L. Tzeng[1,2], Shih-kuen Cheng[1]; [1]National Central University, Taiwan, [2]Academia Sinica, Taiwan — Although functional neuroimaging studies of episodic memory retrieval consistently found activations over the left posterior parietal cortex (LPPC), very few neuropsychological or brain-stimulation studies provide evidence for the causal relationship between the LPPC and memory retrieval. This study employed the transcranial direct current stimulation (tDCS) to examine whether LPPC is necessarily involved in memory retrieval. Anodal and cathodal stimulations are known to increase and decrease neuronal excitability. If LPPC is necessarily involved in memory retrieval, stimulating this region with anodal or cathodal should respectively increase or decrease memory performance. Forty-eight university students participated in the main experiment, with 24 in the sham-anodal group and the others in the sham-cathodal group. Each participant visited the laboratory twice for two study-test source memory tests. In one visit, all participants received sham stimulation over the P3 site (of the 10-20 system) for an interval of 10 minutes between study and test. For the other visit, participants in the sham-anodal group received anodal stimulation and those in the sham-cathodal group received cathodal stimulation. Another 48 participants were recruited for the control experiment, which employed the same design as the main experiment except that the stimulation site was the left primary motor cortex (M1).The results showed that the old/new recognition performance was increased after anodal stimulation and decreased after cathodal stimulation over the LPPC. No such effects were found in the control experiment where the M1 was stimulated. This finding therefore provides solid evidence for the causal relationship between the LPPC and retrieval processes.

E68

ELECTROPHYSIOLOGICAL CORRELATES OF EXPLICIT AND IMPLICIT RECOGNITION OF NATURAL SCENES Mathias Weymar[1], Nasryn El-Hinnawi[1], Margaret Bradley[1]; [1]University of Florida — Research in the neuroscience of human memory has converged on a distinction between explicit and implicit forms of memory. In the present study, we investigated the brain dynamics of the mechanisms underlying implicit and explicit retrieval of natural scenes using high-density event-related potentials (ERPs). In three separate experiments we tested whether the ERP old/new effect, an electrophysiological correlate of successful recollective experience, is modulated by hedonic content and task. Participants viewed 36 pictures varying in emotional content (12 unpleasant vs. 12 pleasant vs. 12 neutral). Following encoding, one group performed an explicit recognition task, in which participants indicated whether a picture had been previously seen (old) or not (new). A second group performed an implicit categorization task (one person vs. more) and a third group passively viewed old and new pictures without any task. Results showed that explicit recognition was associated with enhanced centroparietal positivity (500 and 700 ms) for old, compared to new, pictures. There were no significant old/new differences in the ERPs when old and new pictures were presented in the person categorization task. During passive viewing, only emotional pictures showed old/new differences. The present results suggest that parietal old-new ERPs depend on the explicit memory task, with no difference when both old and new items are task-relevant (e.g., implicit). Furthermore, only emotional scenes show evidence of previous occurrence in ERPs in a no task condition.

E69

THE CONTRIBUTION OF SLEEP STAGE II TO THE CONSOLIDATION OF EPISODIC MEMORIES Simon Ruch[1,2], Oliver Markes[1,2], Simone Duss[1,2], Daniel Oppliger[1,2], Thomas P. Reber[1,2], Thomas Koenig[3], Johannes Mathis[3], Corinne Roth[3], Katharina Henke[1,2]; [1]Department of Psychology, University of Bern, Muesmattstrasse 45, 3012 Bern, Switzerland, [2]Center for Cognition, Learning, and Memory, University of Bern, Bern, Switzerland, [3]Department of Psychiatric Neurophysiology, University Hospital of Psychiatry, University of Bern, Bern, Switzerland, [4]Department of Neurology, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland — Various studies suggest that non-rapid eye movement sleep (NREM), especially the deep sleep stage slow-wave sleep (SWS), is vital to the consolidation of episodic memories. Memory consolidation is assumed to benefit from specific neuronal events occurring during NREM sleep. These events manifest themselves as sleep spindles and slow-waves in the electroencephalogram of NREM. While insight into the contribution of NREM and SWS to the consolidation of episodic memories is growing, little is known about whether and how sleep stage 2 is involved in consolidation processes. Sleep stage 2 (S2) is the other, lighter NREM stage besides SWS. The current study investigated whether S2 during an afternoon nap contributes to the consolidation of episodic memories. Participants (N=24) learned associations between faces and cities prior to a brief nap. A cued recall task was administered before and following the nap to measure memory retention across sleep. Sleep spindles and slow-wave activity were recorded during S2 in the nap following episodic learning and in a

control nap. Spindle and slow-wave activity recorded during S2 following learning was correlated with retention. Furthermore, subjects who displayed an increase in spindle activity and slow-wave activity in S2 during the nap following learning compared to the control nap showed a better retention of face-city associations. This indicates that not a subject's average spindle and slow-wave activity, but specifically learning-induced spindle and slow-wave activity supports memory consolidation in S2.

E70

EMOTIONAL MEMORY IN SCHOOL-AGE CHILDREN Jacqueline S. Leventon[1], Jennifer Strafford Stevens[1], Patricia J. Bauer[1]; [1]Emory University — Adults demonstrate more robust memory for emotional relative to neutral events ("emotion effect"). In order to investigate the development of emotional memory processes, we examined children's encoding and retrieval of positive, negative, and neutral IAPS images with a combination of behavioral and electrophysiological measures. Children (ages 5-8 years old) came to the lab for two visits, separated by a 24-hour delay. At session 1, children's encoding of positive, negative, and neutral images was measured via event-related potentials (ERPs). At session 2, children's retrieval of the images was assessed in a recognition paradigm, measured by ERPs (responses to old vs. new images) and behavioral responses (hits and misses to old images, correct rejections and false alarms to new images). At both encoding and retrieval, children demonstrated robust emotion effects in their ERP responses (larger and sustained positive amplitudes to emotional vs. neutral images across frontal, central, and posterior clusters). Children also demonstrated robust memory effects in their ERP responses at retrieval (larger and sustained positive amplitudes to old vs. new images across the head). In their ERP responses, the interaction of emotion and memory was not observed (no "emotion effect" during retrieval). However, children's behavioral responses are suggestive of an emotion effect on memory: children made significantly more hits to negative vs. neutral images and significantly more false alarms to positive vs. neutral images. These findings represent the first investigation of the development of the enhancing effect of emotion on memory, and suggest that emotion influences school-age children's memory performance.

LONG-TERM MEMORY: Other

E71

EVENT-RELATED POTENTIAL (ERP) EVIDENCE FOR SEPARATE FLUENCY AND FAMILIARITY PROCESSES DURING RECOGNITION Kevin Zish[2,1], P. Andrew Leynes[2]; [1]Rutgers Center for Cognitive Science, [2]The College of New Jersey — Fluency, the ease of stimulus processing, is increased by prior exposure or by enhancing stimulus clarity. Although more fluent processing can lead to either real or false sense of familiarity (Whittlesea, 1993), the literature is dominated by studies that separate familiarity and recollection during recognition. The few Event-Related Potential (ERP) studies that have focused on the neural correlates of fluency have used repetition to increase fluency (i.e., repetition fluency). The present study isolated perceptual fluency effects on ERP activity by manipulating visual clarity of words during recognition. In Experiment 1, visual clarity of previously studied and new words was held constant across blocks of trials, whereas clarity varied randomly across trials in Experiment 2. Prior studies have identified a frontally located negative ERP occurring 300-500 ms that is more positive for familiar items (i.e., FN400). Similar to previous fluency ERP studies, the present studies detected a fluency ERP that was distinct from the FN400 on the basis of time (fluency ERP peaked earlier 280-400 ms), spatial location (fluency ERP was maximal at parietal sites), and characteristics (old items were more negative for fluency ERP). Furthermore, the results suggest familiarity was influenced by visual clarity when it varied randomly across trials but not when it was constant in blocks. Collectively, the neural measures support emerging theories of memory that posit fluency and familiarity are separate, but related, cognitive processes.

E72

THE RIGHT WAY: THE IMPORTANCE OF HIPPOCAMPAL LATERALIZATION IN SPATIAL MEMORY PERFORMANCE Jonas Persson[1], Jonas Engman[1], Arvid Morell[1], Johan Wikström[1], Hedvig Söderlund[1]; [1]Uppsala University, Sweden — Sex differences in spatial memory favoring men have been well-established in prior research, as has the involvement of the hippocampus in this function. However, little is known of whether this behavioral difference is related to differences in hippocampal activation. Here, we investigated this question, using a spatial computerized task. Twenty-four participants (12 men, 12 women, 25.0±3.0 years of age) navigated through virtual mazes and were, upon reaching the end, asked to point towards the start of the maze. As expected, men were more accurate in their assessments than women. For the functional data the initial navigating and subsequent pointing phases were analyzed separately, both revealing activation of the posterior hippocampus in all participants. However, while men displayed right-sided activation during the navigation phase, women showed bilateral activation. This pattern was confirmed in an analysis of extracted ROI-data where a sex-laterality interaction was found. A laterality index of hippocampal activation in the navigation phase, calculated for each participant, showed a significant relationship with performance where right-lateralized activity was associated with better performance. Taken together, these findings show a greater lateralization of the hippocampus during a spatial memory task in men than in women, which may partly explain the frequently observed sex-difference in spatial memory.

E73

INVOLVEMENT OF THE HUMAN MEDIAL TEMPORAL LOBE IN A VISUAL DISCRIMINATION TASK Robert Lech[1,2], Boris Suchan[1,2]; [1]Institute of Cognitive Neuroscience, Ruhr University Bochum, [2]International Graduate School of Neuroscience, Ruhr University Bochum — Recent research suggests a role of the human medial temporal lobe (MTL) in the processing of complex visual stimuli, apart from its established role in long-term declarative memory processing. The aim of this study is to further elucidate the contributions of different MTL structures to perceptual and mnemonic processing using functional magnetic resonance imaging (fMRI). Twenty healthy right-handed subjects participated in this study, each attending two experimental sessions in a 3T magnetic resonance scanner. In the first task, participants had to discriminate visual stimuli (faces and scenes) in an oddball paradigm. Three trial unique stimuli were presented simultaneously to reduce memory demands. In the second task, participants had to encode unfamiliar faces and scenes. One week later, these stimuli were presented together with distractors and additional stimuli from the oddball task. The remember-know procedure was employed to assess recognition memory. Imaging data reveals strong bilateral activity in primary visual areas extending through the ventral stream into the parahippocampal gyrus and hippocampus for the visual discrimination task (without explicit memory demands). Behavioural data suggest that only a small fraction of the stimuli from this task was encoded incidentally, as opposed to the stimuli that had to be memorized explicitly in the second task (resulting in perirhinal/hippocampal activity). By minimizing memory demands and controlling for incidental encoding we could show a significant activation of MTL structures in a visual discrimination task, which points to an involvement beyond memory processing. Therefore, these results provide further support for a perceptual-mnemonic theory of the MTL.

E74

A ROLE FOR GAMMA OSCILLATIONS IN THE COORDINATION OF THE RETRIEVAL OF LEARNED SPATIAL REPRESENTATIONS Raphael Kaplan[1,2,3], Mathilde Bonnefond[4], Ole Jensen[4], Peter Bandettini[2], Neil Burgess[3], Christian Doeller[4]; [1]UCL-NIMH Joint Graduate Partnership Program in Neuroscience, [2]Section on Functional Imaging Methods, Laboratory of Brain and Cognition, National Institute of Mental Health, [3]Institute of Cognitive Neuroscience; University College London, [4]Donders Centre for Cognitive

Neuroimaging, Donders Institute for Brain, Cognition and Behaviour; Radboud University, Nijmegen, Netherlands — High frequency oscillations have been hypothesized to be important for cognition by carrying out different local computations and binding information between different brain regions. Meanwhile, low frequency hippocampal theta oscillations have a vital role in spatial cognition. Recent models have focused on the relationship between memory performance and cross-frequency interactions between hippocampal theta and higher frequencies. Based on these models, we were interested in examining the role of high frequency gamma activity in coordinating spatial memories prior to retrieval and how that relates to subsequent retrieval performance and previously observed hippocampal theta. Using non-invasive whole head Magnetoencephalography (MEG) recordings in healthy volunteers, we analysed high frequency oscillatory activity during a virtual reality spatial navigation task. Similar to rodent electrophysiology studies, participants were instructed to navigate and learn object locations within a virtual environment in a self-directed fashion. To assess subsequent performance, each learning phase had a separate test phase where participants would be cued by a picture of a previously tested object before navigating to the spot where they thought it was originally located. High and low gamma power increases during the cue period were found to be predictive of subsequent retrieval performance in anterior and posterior scalp regions. We also compared performance-related gamma sources with previously anatomically localized hippocampal theta. Cross-frequency interactions were measured that show that phase-amplitude coupling helps to coordinate the retrieval of spatial information.

E75

REINFORCEMENT LEARNING ENHANCES MNEMONIC REPRESENTATIONS OF NEUTRAL STIMULI Joseph E. Dunsmoor[1], Alex Martin[2], Kevin S. LaBar[1]; [1]Duke University, [2]National Institute of Mental Health — Emotional benefits on declarative memory formation are linked to a network of brain regions, including the amygdala and hippocampus. In typical emotional memory paradigms, fMRI activity is compared for subsequently remembered vs. forgotten items as a function of their inherent emotional properties. However, neutral objects often attain emotional significance through reinforcement learning and generalization processes. The memory benefits of learned emotional associations are unclear, since typical conditioning protocols use only one item as a conditioned stimulus. We developed a novel approach that integrates fear conditioning and the subsequent memory paradigm to identify how reinforcement learning promotes successful encoding for items belonging to specific object categories. During fMRI, subjects viewed different images of animals and tools. Objects from one category were intermittently paired with an electrical shock while the other category was never reinforced. Twenty-four hours later, subjects completed a surprise recognition memory test. Memory was enhanced for objects from the reinforced versus unreinforced category. FMRI results showed activity in the hippocampus and midbrain during conditioning predicted enhanced subsequent memory for objects from the reinforced category relative to the unreinforced category. Furthermore, conditioning-related activity in the amygdala correlated with individual differences in these emotional memory benefits. These findings demonstrate that fear conditioning can recruit emotional memory systems to yield long-term memory benefits for neutral stimuli. These results have implications for understanding how stimuli with no inherently emotional properties can yield long-lasting impressions in memory. Clinical extensions of this research may reveal mechanistic insights into biased memory representations in affective disorders.

E76

THE CONTRIBUTION OF SLOW-WAVE SLEEP TO THE REORGANIZATION OF EMOTIONAL MEMORY: AN FMRI STUDY Scott Cairney[1], Rebecca Power[1], Simon Durrant[2], Penelope Lewis[1]; [1]University of Manchester, UK., [2]University of Lincoln, UK. — Slow wave sleep (SWS) is thought to facilitate a reorganization of declarative memory, whereby retrieval dependency is transferred from the hippocampus to the neocortex. We investigated the SWS-associated reorganization of memories that were emotionally positive, negative or neutral. Sixteen participants undertook two experimental sessions. In the first (3pm ±1.5 hours), 90 positive, negative and neutral images were encoded. At 10pm, participants slept overnight and were monitored with polysomnography. In the second session (~24 hours after session one), participants encoded another 90 images and then undertook a recognition test in an MRI scanner for all session one (remote) and session two (recent) images. There was no difference in memory performance for remote or recent images, irrespective of valence. However, the degree of superiority for negative remote (vs. recent) memory performance was correlated with SWS obtained overnight ($r = 0.65$, $p = 0.006$). FMRI region of interest (ROI) analyses showed a SWS-dependent reduction in hippocampal activity for global remote (vs. recent) retrieval ($p < 0.05$ Family-Wise Error corrected). An ROI in the right amygdala revealed an exclusive SWS-related reduction of activity in this region for negative remote (vs. recent) retrieval. Our findings provide support for a SWS-dependent shift in declarative retrieval dependency away from the hippocampus, and demonstrate a reduction in amygdala activity associated with negative remote retrieval, also mediated by SWS. As such, SWS may not only drive neural reorganisation, but also prevent the affective tone associated with emotional materials at encoding from resurfacing during their subsequent retrieval.

E77

PHARMACOLOGICAL EFFECTS ON THE TEMPORAL AND OSCILLATORY DYNAMICS OF NOVELTY PROCESSING Cindy Eckart[1], Nico Bunzeck[1]; [1]University Medical Center Hamburg-Eppendorf, Hamburg, Germany — Dopamine (DA) and acetylcholine (ACh) have long been recognized to play an important role in novelty processing, but their relationships with underlying temporal and oscillatory mechanisms still remain unclear. To further address this issue, we used magnetoencephalography (MEG) in combination with a task that allowed us to study the neural dynamics of novelty processing and their interaction with either levodopa (dopamine precursor) or galantamine (acetylcholinesterase inhibitor). More precisely, subjects were presented with novel and repeated (i.e., familiar) pictures of scenes and indicated their indoor/outdoor status using button presses. As a main finding, we can show that, in contrast to placebo, levodopa accelerated neural novelty signals from ~200 ms to <100 ms after stimulus onset over left temporal sensors. Galantamine, on the other hand, did not accelerate onset latencies but shifted the topographical representation of the novelty signal from temporal to prefrontal sensors. Within the oscillatory domain, the placebo group revealed characteristic increases in theta power (5-8 Hz) as a function of stimulus repetition over central sensors. This effect was reduced by levodopa and galantamine with a peak at ~160 ms after stimulus onset. Finally, within the gamma band range (30-50 Hz) power was reduced by stimulus repetition and this effect was modulated by galantamine but not levodopa. Taken together, our results demonstrate that levodopa and galantamine differentially modulate the temporal and oscillatory dynamics of neural novelty processing. As such, our findings conform to and extend previous models of dopaminergic and cholinergic novelty processing

METHODS: Neuroimaging

E78

ACUTE AND DELAYED-ONSET EFFECTS OF HYDROCORTISONE ADMINISTRATION ON PREFRONTAL GLUTAMATE AND GLUTAMINE Param Bhardwaj[1], Changho Choi[2], Peter Seres[2], Rawle Carter[1], Kathleen Hegadoren[3], Nick Coupland[1]; [1]Psychiatry, [2]Biomedical Engineering, [3]Nursing — Clinical research has shown corticosteroid dysregulation in stress-related psychiatric disorders. Corticosteroids effect cellular excitability, learning, memory, and involve changes in glutamate (Glu) neurotransmission and Glu metabolic cycling with glutamine (Gln). Recent advancements in proton magnetic resonance spectroscopy (1H-MRS) have allowed for independent measures of Glu and Gln. Glu's function

as the most abundant excitatory neurotransmitter may provide greater insight into Glu's role in psychiatric disorders. Our study in healthy volunteers (n=12) suggested that single intravenous administration of a high dose of cortisol (hydrocortisone 35mg) rapidly reduced prefrontal Gln, a result sustained acutely for at least 30 minutes. This may represent Gln efflux from the astrocyte compartment, caused by consumption of Gln to maintain neuronal Glu levels in response to glucocorticoid increases. Subsequent research examines the effects of subacute repeated hydrocortisone on prefrontal Glu and Gln. Given that preclinical data indicate corticosteroids induce expression of Gln-synthetase, the astrocytic enzyme catalyzing the Glu to Gln reaction, we predict hydrocortisone will produce a delayed increase in prefrontal Gln and possibly Glu concentrations. Using 1H-MRS and spectrally-selective refocusing at 3.0 T in a blinded design, subjects were administered hydrocortisone for 3 days at a dosage of 40mg (n=8) or 100mg (n=8) daily. Glu and Gln measures were obtained pre- and post-administration. With chronic hydrocortisone administration, Glu increases in day 3 and returns to normal in day 4 upon corticosteroid termination. This suggests acute hydrocortisone infusion leads to rapid, non-transcriptional changes in Gln, while delayed-onset administration leads to genomic alterations in central Glu concentrations.

E79

INFORMATION REVEALED BY MULTI-VOXEL PATTERN ANALYSIS: WHAT MAKES A PATTERN? Philip A. Kragel[1], R. McKell Carter[1], Scott A. Huettel[1]; [1]Duke University — A central goal of cognitive neuroscience is to understand how the activity of neurons represents information in the brain. Multi-voxel pattern analysis (MVPA) is a promising analytical tool for examining the ways in which the activity of neurons can represent cognitive states. The primary advantage of MVPA over standard neuroimaging analysis methods is its capacity to detect information carried across multiple voxels, rather than individual voxels. This novel methodology is expanding the way in which patterns of brain activity are characterized. Here, we use a combination of meta-analysis and simulations to show that while the majority of MVPA studies use linear algorithms, some sources of pattern information can only be decoded using non-linear approaches. Examining 107 functional magnetic resonance imaging studies employing MVPA, we identify the algorithms used for classification and inferences made about how information is carried in neuronal activation patterns. Multivariate linear classifiers (the majority of MVPA studies, 101 of 107) improve upon standard mass-univariate analysis by improving sensitivity while providing voxel weights that are easy to interpret. While linear classifiers can more easily tolerate heterogeneous relationships between voxels, the patterns they reveal are largely accessible to standard analyses. However, non-linear classifiers (24 of 107, some use linear and non-linear) allow the identification of pattern information beyond standard methods. In the end, both types of classifiers can provide additional insight into the information contained in neuroimaging data. We encourage the use of linear and nonlinear algorithms to identify and interpret signals carried through the interaction of multiple voxels.

E80

THE EXAMINATION OF WHITE MATTER CORRELATES WITH LETTER AND CATEGORY FLUENCY IN FRONTOTEMPORAL LOBAR DEGENERATION WITH TWO DIFFUSION TENSOR IMAGING APPROACHES. Jeremy Strain[1], Ramon Diaz-Arrastia[3], John Hart[1,2], Kyle Womack[1,2]; [1]University of Texas at Dallas, [2]The University of Texas Southwestern Medical Center at Dallas, [3]The Center for Neuroscience and Regenerative Medicine, Uniformed Services University for the Health Sciences — Patients with frontotemporal lobar degeneration (FTLD) exhibit deficits in verbal fluency measures. Letter fluency with FAS is dependent on frontal lobe function while category fluency is more dependent on dispersed semantic networks. We investigated the dependence of these two tasks on white matter integrity in patients with FTLD using a voxel-wise approach as well as a novel global measure. Subjects: 28 cognitively normal controls (NC), and 28 patients with FTLD (Mean age = 63.4, Female/Male = 9/19). Method: Diffusion Tensor Images (DTI) were processed and analyzed using Tract Based Spatial Statistics from the brain-imaging program FSL. Effects of age, gender and global function (MMSE score) were removed before further analyses. Voxel-wise correlations of DTI metrics and verbal fluency were performed. To measure global white matter impairment, Z-scores for DTI metrics from all skeletonized voxels were calculated and the number of voxels with a z-score exceeding 4 were tallied. Spearman correlations between the log transform of this value and verbal fluency measures were performed. Results: A number of frontal voxels were found in which fractional anisotropy (FA) or mean diffusivity (MD) correlated with FAS performance (?=0.05 corrected); however, no voxels had significant correlations with category fluency. Category fluency was correlated with our global white matter measure. Category and letter fluency correlated with our global white matter measured (?=0.05). Conclusions: The data suggests that semantic processing is a more diffuse process than letter fluency and likely utilizes several white matter pathways, damage to any of which may result in decreased performance.

E81

THE NEURAL REGULARITY HYPOTHESIS: THE RELATIONSHIP BETWEEN BOLD ACTIVITY, AGE, HEALTH, AND COGNITION Ian McDonough[1,2], Andrew Hebrank[1,2], Kristen Kennedy[1,2], Karen Rodrigue[1,2], Denise Park[1,2]; [1]University of Texas at Dallas, [2]Center for Vital Longevity — Variability in physiological signals (e.g., heartbeat fluctuations) increases in regularity (or predictability) with age and has been suggested to be a biomarker for predicting health outcomes. The current experiment explored how regularity in neural activity, as measured by the BOLD signal in fMRI, differs with age and tested whether this regularity correlated with scores of health and cognition. In the scanner, 30 young (ages 20-29) and 28 healthy older adults (ages 70-79) made living/non-living judgments to words. The regularity of the BOLD time series was calculated for each voxel across the whole brain using an established entropy equation on physiological time series data. Regularity in the BOLD time series differed with age across various brain regions. Dorsolateral frontal, parietal, and inferior temporal regions decreased in regularity with age while superior temporal and medial temporal regions increased in regularity with age. Across all ages, increased regularity in dorsolateral regions and decreased regularity in medial temporal regions were associated with better self-reported health and cognition (executive functioning, fluid intelligence, working memory, processing speed, and long-term memory). Correlations in the opposite direction were found for measures of crystalized intelligence. Thus, analyzing the regularity of the BOLD signal serves as novel method to investigate neural activity and has promise to serve as a biomarker for changes in health and cognition. Regularity in the BOLD signal may represent a correlate of neural efficiency or stability, which is disrupted in advanced age.

E82

THE ADVANTAGE OF BRIEF FUNCTIONAL MAGNETIC RESONANCE IMAGING ACQUISITION RUNS FOR MULTI-VOXEL PATTERN DETECTION Marc N Coutanche[1], Sharon L Thompson-Schill[1]; [1]University of Pennsylvania — Investigators are faced with a large variety of options when planning a functional magnetic resonance imaging (fMRI) study. One factor, the runs (or 'sessions') in an fMRI scan, are often selected to be long, to minimize across-run signal variation. For studies using multi-voxel pattern analysis (MVPA), however, employing a large number of short runs might improve a classifier's ability to generalize across irrelevant signal variation and correctly detect condition-driven activity patterns. Our goal in this study was to directly test this idea. Ten participants were scanned using both long and short runs containing presentations of four stimulus categories – faces, places, man-made objects and fruit – in a blocked 1-back design. We compared MVPA performance using data from four long versus sixteen short runs. With the quantity of data and cross-validation structure held constant, MVPA performance was significantly improved using data from the short runs compared to data from the long runs. Superior classification performance was found across vari-

ations in the classifier employed, feature selection procedure and regions of interest. Performance improvements were also present in an information brain mapping 'searchlight' procedure. These results suggest that investigators looking to maximize their ability to detect subtle multivoxel patterns might wish to consider employing short fMRI runs.

E83

FIVE-YEAR CHANGES IN BRAIN VOLUME AND EPISODIC MEMORY IN COGNITIVELY INTACT ELDERS WITH AND WITHOUT AN APOLIPOPROTEIN ?4 ALLELE Monica A. Matthews[1], Michael Seidenberg[1], John L. Woodard[4], Sally Durgerian[2], Kristy A. Nielson[2,3], J. Carson Smith[5], Melissa A. Lancaster[1], Alissa M. Butts[3], Nathan C. Hantke[3], Stephen M. Rao[6]; [1]Rosalind Franklin University of Medicine and Science, [2]Medical College of Wisconsin, [3]Marquette University, [4]Wayne State University, [5]University of Maryland, [6]Cleveland Clinic — The apolipoprotein ?4 allele is a risk factor for Alzheimer's disease. ?4 carriers diagnosed with AD or MCI exhibit an increased rate of atrophy on MRI relative to non-carriers. Few longitudinal studies have examined the rate of atrophy and cognitive change in older ?4 carriers who were cognitively intact at study entry. In this study, structural MRI and episodic memory testing were administered on two occasions separated by 5 years to 45 cognitively intact older adults, ages 65-90 years, divided into two groups: (1) carriers with one or both ?4 alleles (n=24) and (2) demographically-matched non-carriers (n=21). Longitudinal analysis of whole brain gray matter, whole brain white matter, and hippocampal volumes were derived from Freesurfer software. Analysis of variance indicated a significant group x time interaction for both left and right cortical gray matter (p's < .05; 2% decrease) and left hippocampus ($p < .001$; 5.6% decrease); right hippocampus showed a marginal effect (p=.086; 4.9 % decrease). In all instances, the ?4 group showed greater atrophy over the five-year interval than non-carriers. White matter brain volume significantly decreased over retest interval (3.5%), but did not differ between groups. Over the same retest interval, the ?4 group also showed significantly greater decline than non-carriers on delayed word recall and percent retention on a list-learning task. These data suggest that the presence of an ?4 allele carries an increased risk for cortical gray matter and hippocampal atrophy and memory loss among older participants who were cognitively intact at study entry.

E84

COMBINING MULTIPLE DATASETS TO UNCOVER TASK-COMMON AND TASK-SPECIFIC NETWORKS UNDERLYING INTEGRATION OF EVIDENCE USING FMRI-CPCA Katie Lavigne[1,2], Paul Metzak[1,2], Todd Woodward[1,2]; [1]University of British Columbia, [2]BC Mental Health and Addictions Research Institute — We investigated functional networks associated with the integration of evidence using event-related functional magnetic resonance imaging (fMRI). This was achieved by combining data from two studies using conceptually similar tasks with constrained principal component analysis for fMRI (fMRI-CPCA). fMRI-CPCA is a multivariate analysis method combining multiple regression and principal component analysis that allows for the extraction of task-related functional networks. When applied to conceptually similar tasks from multiple datasets, fMRI-CPCA can distinguish between functional networks that are common to all tasks and those that are task-specific. 27 healthy participants completed one of two versions of a perceptual interpretation task, in which they rated the degree to which a morphed image composed of two different animals (e.g., cat, fox) appeared to be an image of one animal or the other. Participants were then presented with a second image of the animals morphed at a different ratio and were asked to re-rate the images. fMRI-CPCA revealed five functional networks, the largest of which included bilateral activations in anterior prefrontal regions known to be involved in evaluating internally-generated information. This network was specifically responsive to integration of disconfirmatory evidence for both versions of the task, suggesting that it was a task-common functional network associated with disconfirmatory evidence integration, and unrelated to methodological differences between the two tasks (e.g., differences between the timing of the stimuli). Multiple task-specific attention and response networks were also identified.

E85

IDENTIFYING COMPUTABLE FUNCTIONS AND THEIR SPATIOTEMPORAL DISTRIBUTION IN THE HUMAN BRAIN Andrew Thwaites[1,2], Ian Nimmo-Smith[2], Elisabeth Fonteneau[1,2], Roy D. Patterson[1], Paula Buttery[1], William D. Marslen-Wilson[1,2]; [1]University of Cambridge, [2]MRC Cognition and Brain Sciences Unit, Cambridge — An important goal for cognitive neuroscience is to identify the specific computations carried out by the human brain and to relate these to specific spatio-temporal patterns of neural activity. This can be achieved by testing computationally explicit models of neural functions against spatiotemporally accurate measurements of brain activity. We report here a new approach that can search representations of neural activity, captured by combined electro- and magneto-encephalographic (EMEG) whole brain recordings, to determine the neural distribution of appropriately and rigorously defined computational functions. Focusing on speech comprehension, we show how this technique can locate computational functions relating to two very different aspects of this complex process: signal based processes related to the extraction of perceptual features (loudness and pitch) and knowledge-based processes operating on the listener's representation of words in their language. Using a combination of signal correlation techniques and a temporal moving window to search EMEG source space on a searchlight basis, we are able to identify a loudness process running in L and R planum temporale at lags of 65-70 ms and 75 ms, a pitch process close to L Heschl's gyrus at 65 ms and R planum temporale at 85 ms, and a primary set of word-recognition processes running in L and R temporal lobes at 235-250 ms. These successful applications of the technique demonstrate its potential to map out the computational functions underpinning complex neurocognitive capacities.

E86

DISTINGUISHING FUTURE COGNITIVE DECLINE IN HEALTHY ELDERS USING TWO METHODS FOR MEASURING HIPPOCAMPAL VOLUMES Alissa M. Butts[1], Kristy A. Nielson[1,2], Nathan Hantke[1], Melissa Lancaster[3], Michael Seidenberg[3], John L. Woodard[4], J. Carson Smith[5], Monica Matthews[3], Michael A. Sugarman[4], Sally Durgerian[2], Stephen M. Rao[6]; [1]Marquette University, [2]Medical College of Wisconsin, [3]Rosalind Franklin University of Medicine and Science, [4]Wayne State University, [5]University of Maryland, [6]Cleveland Clinic — Alzheimer's disease (AD) pathology is thought to begin years before symptom onset. Hippocampal volume is sensitive to predicting conversion from MCI to AD. We and others have also shown that hippocampal volumes can predict future cognitive decline in cognitively intact older adults. The most sensitive methods for measuring hippocampal volumes are unknown. We compared two methods, automated FreeSurfer (FS) software versus manually traced (MT), to determine their relative sensitivity to distinguish future cognitive decline. Seventy-five cognitively intact elders underwent a baseline and 18-month follow-up neuropsychological testing. Participants were classified as Declining (n=27) or Stable (n=48) based on 18-month change scores on episodic list-learning task and general cognitive functioning scales. All subjects underwent baseline structural MRI scans. A two-way ANOVA (group X method) was conducted to determine the relative sensitivity of baseline MT and FS hippocampal volumes in distinguishing group membership. A significant Group X Method (p=.045) interaction was observed. Post-hoc analyses indicated that baseline MT hippocampal volumes were significantly smaller in the Declining relative to Stable group. In contrast, no group differences were observed using the automated FS method. Group differences were not enhanced by examining left versus right or anterior versus posterior hippocampal volumes. MT hippocampal volume was superior to FS in differentiating healthy older participants who subsequently developed cognitive decline from those who remained stable. These findings suggest that while manual tracings may be more labor intensive, they provide greater clinical utility than FS in identifying individuals at greatest risk for cognitive decline.

E87

PREDICTION OF LONGITUDINAL WHITE MATTER CHANGE IN HEALTHY ELDERLY INDIVIDUALS Melissa Lancaster[1], Sally Durgerian[2], Michael Seidenberg[1], John Woodard[3], Kristy Nielson[2,4], J. Carson Smith[5], Monica Matthews[1], Alissa Butts[4], Nathan Hantke[4], Stephen Rao[6]; [1]Rosalind Franklin University of Medicine and Science, [2]Medical College of Wisconsin, [3]Wayne State University, [4]Marquette University, [5]University of Maryland, [6]Cleveland Clinic — Diffusion Tensor Imaging (DTI) studies have shown that significant alteration in white matter (WM) integrity differentiates healthy older adults from persons with Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD). Most studies, however, have been cross-sectional and have not related longitudinal DTI changes to cognitive change. Here we report changes in WM integrity and cognition in healthy older adults over an 18-month interval. Sixty-seven cognitively intact elders underwent neuropsychological testing and DTI at baseline and after 18 months. Groups were formed based on change from baseline to follow-up on the Rey Auditory Verbal Learning Test (recall sum across trials 1-5, delayed recall) and Mattis Dementia Rating Scale-2. Declining participants (N=21) showed a minimum of 1 SD reduction on at least one cognitive measure, while Stable participants (N=46) showed comparable scores at each time point. WM regions-of-interest were derived from Freesurfer. Hierarchical linear regression was used to predict fractional anisotropy (FA) change in regions frequently identified in DTI studies of MCI and AD including transentorhinal cortex, temporal lobe, and posterior cingulate. Groups did not differ at baseline in age, cognition, FA, or WM volume. After controlling for age and baseline FA, cognitive status (Declining, Stable) predicted the baseline to 18-month reduction in FA in the right hippocampal gyrus (p=.004) and left fusiform gyrus (p=.01) with a trend in the left middle temporal gyrus (p=.06). Future research should examine WM changes in other brain regions and determine whether DTI diffusivity measures are related to cognitive decline.

E88

ASSESSING THE TRAIT-LIKE CHARACTERISTICS OF INTRINSIC CONNECTIVITY Craig Moodie[1], Krista Wisner[1], Angus MacDonald, III[1]; [1]University of Minnesota, Twin Cities — The assumption that sharing an entire genome might bestow twins with analogous neurobiological substrates and congruent cognitive abilities has not yet been examined in the context of intrinsic connectivity. Even though recent studies have revealed endogenous functional networks present at rest and during active states, it remains to be seen to what extent these brain networks might cohere or vary across individuals according to heritable factors. This study quantifies morphometric similarities between twins in the context of task-related activation in order assess whether or not familial psychometric phenotypes vary in a trait-like fashion. fMRI data from monozygotic twins participating in the Minnesota Trust Game, hand imitation and verb generation tasks were collected on a Siemens 3T scanner and processed via the FSL imaging analysis software. Statistical analyses of task-related activation and independent component networks were then used to generate voxel-wise and intraclass correlations within and across twin pairs. It was found that functional connectivity was higher within twin pairs than across all individuals, and that twin group assignment improved models predicting the relative strength of network connectivity. Additionally, the observed components in each paradigm were both task-relevant and analogous to previously established networks. Trait-like networks that lead to morphometric similarities, and that are associated with task-related brain activation, were discovered across paradigms and, consequently, it is evident that brain structures and processes are heritable. Moreover, these results suggest that variations in heritable network dynamics can engender individual differences, and can even be explanatory variables for neuropsychiatric illnesses.

E89

NEUROMETRICS OF INTRINSIC CONNECTIVITY NETWORKS: RETEST RELIABILITY AND CROSS-VALIDATION USING A META-LEVEL METHOD Krista Wisner[1], Kelvin Lim[2], Angus MacDonald III[1,2]; [1]Department of Psychology, University of Minnesota, [2]Department of Psychiatry, University of Minnesota — Connectivity of the resting brain can be parsed into distinct networks that closely resemble brain circuits evoked by cognitive tasks such as visual-spatial processing. Although such empirically-derived intrinsic connectivity networks (ICNs) have become a popular method for investigating brain functioning, the relationships between ICNs and a repertoire of cognitive processes have yet to be examined when also considering the neurometrics of the ICNs. Using a meta-level independent component analysis (ICA) to generate the most consistent networks, we produced ICNs from three separate datasets collected from two samples of healthy adults in order to examine the 9 month retest reliability of ICNs and to test the cross-validation of the findings. Functional implications of ICNs were investigated by correlating ICNs with a BrainMap meta-analysis of task-based activity networks (Laird, et al., JCN, 2011). In each dataset, 17 of the 18 BrainMap networks were represented in ICNs derived from resting-state fMRI. Networks associated with vision, interoception, language, and the default mode showed the strongest 3D spatial correlations (3DSC, r ? 0.60) between BrainMap networks and ICNs in all three datasets. Additionally, the retest reliability was greatest for the interoception, language, inhibition, and default mode ICNs (3DSC r ? 0.80; Dice Similarity Index ? 0.70). Furthermore, ICNs associated with the said functions showed the strongest 3DSC (r ? 0.70) between the reliability sample and cross-validation sample. These findings illustrate the robustness of a large set of ICNs from resting-state data and demonstrate the neurometric properties that make this approach practical for studying individual differences.

E90

EXTENSIONS TO THE NEUROSYNTH FRAMEWORK FOR LARGE-SCALE AUTOMATED SYNTHESIS OF FUNCTIONAL NEUROIMAGING DATA Tal Yarkoni[1], Russell A. Poldrack[2], David C. Van Essen[3], Tor D. Wager[1]; [1]University of Colorado Boulder, [2]University of Texas at Austin, [3]Washington University School of Medicine — The explosive growth of the human neuroimaging literature has led to major advances in understanding of human brain function, but has also made aggregation and synthesis of neuroimaging findings increasingly difficult. To address this problem, we recently introduced a highly automated brain mapping framework called NeuroSynth that uses text mining, meta-analysis and machine learning techniques to generate a large database of mappings between neural and cognitive states (Yarkoni et al, 2011). The NeuroSynth framework can be used to automatically conduct large-scale, high-quality neuroimaging meta-analyses, address long-standing inferential problems in the neuroimaging literature (e.g., how to infer cognitive states from distributed activity patterns), and support accurate 'decoding' of broad cognitive states from brain activity in both entire studies and individual human subjects. Here we describe new extensions and improvements to this framework, including (i) a more flexible search and analysis interface that lets users dynamically define sets of activation coordinates for real-time analysis; (ii) new algorithms for automatically detecting experimental contrasts, sample size, and stereotaxic space information; (iii) topic modeling-based meta-analysis images to supplement existing term-based images; (iv) preliminary integration with a new stand-alone visualization service that supports user-uploaded images; (v) preliminary integration with a "Neuroimaging Coordinate Repository" designed to support manual validation of automatically extracted data; and (vi) a pilot crowdsourcing interface that lets other researchers annotate and code existing information in the database. These additional features extend the functionality of the existing platform by improving usability, broadening the range of potential applications, and promoting interoperability with other neuroinformatics platforms.

PERCEPTION & ACTION: Motor control

E91

INFORMATION PROCESSING IN THE BRAIN DURING DUAL TASK AND TASK SWITCHING: A META-ANALYSIS Britta Worringer[1], Iring Koch[2,3], Simon Eickhoff[4], Claudia Rottschy[4,5], Ferdinand Binkofski[1]; [1]Section for Clinical and Cognitive Neurosciences, Department of Neurology, University Hospital Aachen, Germany, [2]Department of Psychology, RWTH Aachen University, Germany, [3]Department of Psychology, Max Planck Institute for Human Cognitive and Brain Sciences Leipzig, Germany, [4]Institute of Neurosciences and Medicine (INM-2, INM-3), Juelich Research Centre, Germany, [5]Department of Neurology, University Hospital Aachen, Germany — Although both paradigms task switching and dual task seem to share common mechanisms regarding the execution of two tasks at the same time or in close succession, they have been investigated in both psychological and neuroimaging research independently of each other. Notwithstanding, regarding neuroimaging research both approaches have been consistently focused on frontal areas, which have been hypothesised to create a neuronal bottleneck during the execution of two tasks. To investigate differences and commonalities in the neural correlates during the execution of both paradigms we used GingerALE (Activation Likelihood Estimation) to conduct a coordinate-based meta-analysis of 13 dual task and 18 task switching neuroimaging studies using two-choice reaction tasks. Results show that while task switching evoked more consistent activation bilaterally in supplementary motor area (SMA), dual task performance yielded more consistent activation in left middle and superior frontal areas. A conjunction analysis across dual task and task switching paradigms indicated significant convergence of coordinates reported for either task in left superior parietal lobule (SPL), particularly in areas 7PC and 7A. Results thus support current research suggesting the coexistence of serial and parallel processes within a fronto-parietal network and indicate the neuronal bottleneck to be situated in parietal regions during the process of response selection. Furthermore, more consistent activation in SMA during task switching suggests more demands on updating a task set, while the stronger activation during dual task in left middle and superior frontal areas points to a more demanding top down process concerning motor planning, organization and regulation.

E92

RELATIONSHIPS AMONG ACTION PRODUCTION, ACTION RECOGNITION AND SEMANTICS: INSIGHTS FROM APRAXIA Frank Garcea[1], Bradford Mahon[1,2]; [1]University of Rochester, [2]University of Rochester Medical Center — An important and currently debated issue concerns the nature of the interfaces that obtain between action production and action recognition processes, and between sensory/motor information and conceptual knowledge of actions. Here, we report the performance of a 47 year-old ischemic stroke patient (Case 1) with fronto-parietal damage and a 31 year-old ischemic stroke patient (Case 2) with left posterior parietal damage. Both patients were administered an extensive battery of tasks investigating vision, audition, language, semantic knowledge of actions and objects, and action production and recognition. Normal healthy controls were also administered the same tests. Case 1 was within the control range for visual, linguistic, and auditory processing but impaired for production of transitive actions as well as semantic knowledge of actions. Case 1's production errors in pantomiming transitive actions, using objects, and imitating transitive actions were predominantly spatiotemporal (e.g., body-part-as-object, hand and finger misplacements). While Case 1 was impaired in action production, his recognition of actions he could not produce and his naming of tools was unaffected. Furthermore, his semantic knowledge of tools was largely unimpaired. Case 2's semantic knowledge of actions was impaired to similar levels as was Case 1's; however, her production and recognition of transitive actions was within the control range. These data suggest that the ability to recognize actions and objects does not reduce to simulating the motor programs necessary to use those objects, and place important constraints on neurocognitive theories of action/object recognition.

E93

THE ROLE OF THE PARIETAL OPERCULA IN CODING THE ANATOMICAL COMPONENT OF IMITATION: A TRANSCRANIAL MAGNETIC STIMULATION STUDY. Paola Mengotti[1], Raffaella I. Rumiati[1], Florian Waszak[2], Simone Schütz-Bosbach[3], Luca F. Ticini[3]; [1]SISSA Trieste, Italy, [2]Université Paris Descartes and CNRS, Paris, France, [3]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Human ability to spontaneously imitate movements has been described as a special instance of stimulus-response compatibility. It has been argued that this compatibility has an anatomical component, whereby the performer moves the same effector as the model, and a spatial component, whereby the locations at which the two movements occur is the same. In a recent fMRI study (Mengotti et al. 2011), we showed that the anatomical component of imitation was associated with the activity of bilateral parietal opercula (OP4). We predicted that repetitive TMS over this region would disrupt the anatomical compatibility effect, but not the spatial compatibility. Nineteen right-handed participants underwent TMS stimulation on left and right OP4 while imitating finger movements. A sham condition was included as control. Video-clips showing left/right hands moving the index/ring finger were presented. By asking to imitate the movements according to the anatomical identity (anatomical task) or the spatial position (spatial task) of the stimulus, we created a compatible condition in which both types of compatibility were present and an incompatible condition with only one type of compatibility, according to the task. Post-hoc comparisons (Fisher's LSD) on the compatible condition vs. the incompatible condition revealed that, whereas both types of compatibility were observed in the sham, the anatomical compatibility was not present when stimulating the right OP4. These results suggest an involvement of OP4 in coding the anatomical component of imitation and its role in connecting the imitation network to body representations.

E94

ACTION RECOGNITION CORTICAL NETWORK IN THE MACAQUE MONKEY Hiroaki Ishida[1], Toru Yanagawa[2], Giacomo Rizzolatti[1], Naotaka Fujii[2]; [1]Brain center for motor and social cognition, IIT, Parma, Italy, [2]Laboratory for Adaptive Intelligence, RIKEN BSI, Wako, Japan — A large number of studies showed the existence, in both humans and non-human primates, of a neural mechanism (mirror mechanism) that achieves a basic and direct recognition of actions of others. Although previous neurophysiological studies have taken into account how single cell or small groups of neurons reflect socially-driven action and perception, functional network of social cognitive mechanism still remains largely unknown. We recorded neural activity in two Japanese macaque monkeys by using 128 channels electrocorticogram (ECoG) array that covered almost all of the lateral cortical surface as well as the medial part of prefrontal and parietal cortices. The monkey executed a food grasping or observed the same action done by an experimenter. We compared the power spectrum of neural activity during grasping period of self or experimenter with inter-trial interval (ITI). We found the statistically higher neural activity in premotor cortex, parietal cortex, superior temporal sulcus (STS), supplementary motor area (SMA) and medial prefrontal cortex (area 9) in both self and other's action relative to the ITI. Specifically, neural activity in those regions increased during self and other's action in low-gamma(25-40 Hz) and high-gamma (55-150 Hz) frequency bands. In conclusion, our result confirms that the parieto-premotor and STS circuit is activated during both action observation and execution. We interpret the activation of the prefrontal coretex and SMA/pre-SMA areas during the observation of a grasping-eating action as related to a proactive inhibitory control.

E95

YOUR HAND IS MY HAND! BIMANUAL COUPLING EFFECT IN A SOMATOPARAPHRENIC PATIENT Francesca Garbarini[1], L. Pia[1], A. Piedimonte[1], M. Rabuffetti[2], P. Gindri[3], A. Berti[1]; [1]University of Turin, [2]Foundation Don Carlo Gnocchi IRCCS, Milan, [3]San Camillo Hospital, Turin — When people are required to draw circles with one hand while drawing lines with the other, both the trajectories tend to become ovals (Franz, 2003). Recently, we showed (Garbarini et al. under review) that these effects occur in both actual bimanual movements and when an active limb movement is combined with an illusory limb movement (i.e., anosognosia for hemiplegia). Those results would support the view that coupling effects arises from central signals (e.g., sensory predictions) rather than on actual feedbacks (Franz, 2003). Here we examine whether coupling effects are present also when an active movement is combined with a movement performed by another person's hand, misidentified as one's own hand. One right-brain-damaged-patients affected by left hemiplegia and misidentifications of the experimenter's hand as his own hand (somatoparaphrenia), five hemiplegic patients and ten healthy subjects were administered a bimanual circle-line drawing task. Participants were asked to draw lines with the right hand (baseline) and a) to draw circles with their own left hand b); to draw circles with their own left hand passively moved; c) to observe the examiner drew circle with his left hand positioned in a compatible orientation with respect to the subject's body. Results showed that, in the crucial c) condition, only in the patient who misidentified the experimenter's hand as his own, the lines produced with the right hand were significantly ovalized in respect to the baseline ($p = 0.0001$). These results give interesting new hints regarding the link between body ownership and sense of agency.

E96

FUNCTIONAL ROLE OF PRIMARY MOTOR CORTEX IN MOTOR IMAGERY MEASURED WITH FMRI AND MEG Hana Burianová[1], Paul Sowman[1], Lars Marstaller[1], Graciela Tesan[1], Anina Rich[1], Mark Williams[1], Greg Savage[1], Blake Johnson[1]; [1]Macquarie University, Sydney, Australia — Motor imagery (MI) is an internal rehearsal of a movement without any overt physical action. Neuroimaging studies have demonstrated that the neural mechanisms of MI substantially overlap with the mechanisms of motor execution (ME). Surprisingly, however, the role of primary motor cortex (PMC) remains controversial, as many studies have failed to show consistent activations of PMC during MI, a variability that may be largely due to differences in MI tasks. The objectives of this study were to (1) design a novel task that reliably invokes MI; and (2) compare PMC activations measured with functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG). Participants heard a sequence of auditory cues corresponding to the digits of the right or left hand and responded by raising or lowering the relevant digits, or imagining such movements. At the end of each cue sequence, the participants decided whether their own digit configuration was the same or different from a picture of a hand displayed on the screen. In all participants, fMRI analysis showed PMC activation during MI and ME, and MEG analysis showed significant beta-band desynchronization in the same PMC region at a latency of about 500ms from movement or imagery onset. These results demonstrate that our MI task robustly and reliably activated PMC. This paradigm may thus prove useful in clarifying the precise role of PMC in MI, as well as in examining the functional status of PMC in patients with motor disorders.

E97

FAVOURITISM IN THE SENSORIMOTOR SYSTEM: HISTORY OF INTERACTION MODULATES SIMULATION OF AN ANTICIPATED ACTION Dimitrios Kourtis[1], Natalie Sebanz[1], Günther Knoblich[2]; [1]Donders Institute for Brain, Cognition, and Behaviour, Radboud University Netherlands, [2]Central European University, Budapest, Hungary — The ability to anticipate others' actions is crucial for social interaction. We have recently showed that one simulates in advance an action performed by an interaction partner and practically ignores the same action performed by a person that (s)he never interacts with (Kourtis et. al., Biology Letters, 2010). In the present study we explored the effects of interaction history on action simulation. The setup comprised of an EEG participant, an interaction partner and an "outsider" (i.e. a person only performing individual actions). The task of the EEG participant was to plan and perform an individual action (lifting an object) or a joint action (giving or receiving an object) or to anticipate to observe the same individual action performed by either the partner or the "outsider". The EEG participant had the role of the giver or the receiver in the 1st half of the experiment and the opposite role in the 2nd half; moreover, the partner in one half became the "outsider" in the other half (and vice versa). We recorded stronger mu rhythm (8-12 Hz) decrease over sensorimotor cortex before and during the early stages of the partner's (individual) action in the 1st half of the experiment, but no difference between the partner's and "outsider's" actions in the 2nd half. These findings strengthen the notion that one's sensorimotor system favours the actions of an interaction partner over the same actions performed by an "outsider"; however, this favouritism disappears when the outsider has interacted with the observer in the past.

E98

INTERLIMB COUPLING DUE TO ILLUSORY MOVEMENTS: EVIDENCE FROM ANOSOGNOSIA FOR HEMIPLEGIA Lorenzo Pia[1], Francesca Garbarini[1], Lucia Spinazzola[2], Maurizio Ferrarin[3], Marco Rabuffetti[3], Alessandro Piedimonte[1], Jon Driver[4], Anna Berti[1]; [1]Psychology Department & Neuroscience Institute of Turin (NIT), Turin, [2]Hospital Company 'S. Antonio Abate', Gallarate (Milan), [3]Bioengeneering Center, Foundation 'Don Carlo Gnocchi' IRCCS, Milan, [4]Institute of Cognitive Neuroscience, University College of London, London — In anosognosia for hemiplegia, patients affected by a complete paresis of the side of the body opposite to the brain lesion may claim having performed willed actions with the paralyzed limb despite unambiguous evidence to the contrary. Does this false belief of being able to move reflects the functioning of the mechanisms that govern normal motor performance? By examining in anosognosic patients the temporal coupling effects known to exist during bimanual movements in normal subjects, we demonstrated that the illusory movements of the plegic arm impose to the healthy arm the same constraints that emerge during actual movements. Our findings strongly suggest that the same neurocognitive processes subserving movement execution underpin the 'nonveridical' experience of willed movements in anosognosic patients. Additionally, these data support the view that coupling effects depend on information already within the brain (i.e., a motor representation), rather than on on-line information from the periphery.

E99

NEURAL REFLECTIONS OF STATISTICAL STRUCTURE IN OBSERVED ACTIONS Christiane Ahlheim[1,2], Waltraud Stadler[3,4], Ricarda I. Schubotz[1,2]; [1]Max-Planck-Institute for Neurological Research, [2]Westfälische Wilhelms-Universität Münster, [3]Max-Planck-Institute for Human Cognitive and Brain Sciences, [4]Technische Universität München — The statistical structure of our environment can be used to generate predictions of its future states. The present functional magnetic resonance imaging (fMRI) study aimed at exploring the neural reflections of humans' sensitivity to statistical structure in actions. We developed an arbitrary but naturalistic action syntax. It consisted of particular transition probabilities (0.25, 0.5, 0.75 and 1.0) between six different elements of a construction toy. This setup allowed comparison of the neural effects of observing transitions that did to a larger (probabilities 0.75 and 1.0), or smaller extend (probability of 0.25) accord to the canonical model. On two successive training days, 15 subjects implicitly learnt the syntax by watching clips of action sequences. During the fMRI on the third day they were exposed to the same sequences. Activity increased at points of transitions (grasping new elements versus manipulation of elements) in the posterior middle temporal gyrus, anterior intraparietal sulcus and ventral premotor cortex, suggesting an intensified search for memorized action steps or an intensified matching between memorized and perceived manipulations at the beginning of a new action step. The parametric effect of transition

probability yielded enhanced activation for less frequent transitions in the left posterior middle frontal gyrus and mesial BA6/BA8. We interpret this latter finding as stimulus-informed updating of a situational model, required when an action step with low probability was encountered. High frequent transitions, on the contrary, activated the mesial BA 9, and area that has been associated with successful prediction or detection of coherence.

E100

ROLE OF GOAL AND MOTOR EXPERTISE DURING THE OBSERVATION OF FAMILIAR ACTIONS PERFORMED BY UNUSUAL EFFECTORS Irene Senna[1], Nadia Bolognini[1,2], Angelo Maravita[1]; [1]University of Milano-Bicocca, Department of Psychology, Milano, Italy, [2]Neuropsychological Laboratory, IRCCS Istituto Auxologico Italiano, Milan, Italy — Studies in monkeys and humans suggest the existence of a neural network responding to both execution and observation of actions, i.e. the mirror neuron system (MNS). The MNS activation following action observation is generally believed to hold a precise somatotopic organization, to be specific for actions belonging to the observer's motor repertoire, and to be modulated by individual expertise. The present study sought for motor activation markers witnessing the simulatory coding of the action goal, the effector (usual or unusual) used to perform a given action and the observer's experience relative to the body parts performing the observed action. In separate sessions, the hand and the foot motor area were stimulated by means of Transcranial Magnetic Stimulation (TMS),while participants viewed video-clips depicting grasping or stepping-over-an-object actions performed either with the hand or with the foot. The results showed increased MEPs recorded from the hand by the observation of hand actions (i.e. grasping and stepping over), and also by the observation of a grasping action performed by the foot. MEPs recorded from the foot were only increased by actions performed by the foot. These results show that action observation (e.g. grasping) induces muscular preactivations in the same effector involved in the observed movement, but also in those muscles that are typically used to execute that action (i.e. hand muscles), even when that action is performed by an unusual effector (i.e. the foot).

THINKING: Decision making

E101

THE INFLUENCE OF EPISODIC THOUGHT ON INTERTEMPORAL CHOICE Alejandro De La Vega[1], Jessica Andrews-Hanna[1], Marie Banich[1]; [1]University of Colorado Boulder — Humans show a preference for present rewards over delayed rewards, a phenomenon known as temporal discounting (TD). TD, of perennial interest because of its violation of rational economic theory, is associated with poor outcomes such as drug addiction and perhaps even global warming. Recent research has shown that episodic future thinking can reduce temporal discounting, possibly by modulating subjective valuation processes through imagery-based operations supported by the medial temporal lobe and connecting structures. Interestingly, a growing body of additional research suggests that episodic memory and episodic future thought share similar cognitive processes and neural mechanisms. Given these findings, an immediate question is whether episodic memory can also reduce temporal discounting. To investigate this question, we created a behavioral paradigm whereby participants performed intertemporal choice trials, but each trial was primed by either a brief period of episodic past thought, episodic future thought, or a non-episodic imagery control condition. In line with previous findings, participants discounted future rewards compared to present rewards and showed wide inter-individual variability in their discounting rates. However, when comparing discounting rates between the three conditions, results revealed that episodic memory reduced TD more than episodic future thought and the imagery control condition. In contrast, no differences in TD were observed between the episodic future thought condition and the control condition. Given that the episodic past thought condition was associated with higher self-reported imagery than the episodic future thought condition, these findings suggest that basic episodic imagery processes might play an important role in modulating intertemporal decision-making.

E102

DECISION MAKING ALTERATIONS IN PEOPLE WITH HIV Sara Tomlinson[1], Christopher Power[1], Scot Purdon[1], Esther Fujiwara[1]; [1]University of Alberta, Edmonton, AB, Canada — Human immunodeficiency virus (HIV) infection can lead to impaired neurocognitive functioning; approximately half of individuals infected will experience some neurocognitive symptoms during the course of their illness. Since the advent of highly active retroviral therapy (HAART) in the mid 1990s the type and severity of impairment have evolved. The new profile of HIV neurocognitive alteration more often implicates executive functions than the subcortical-dementia pattern previously observed. While the severity of impairment has improved, general prevalence remains unchanged. In the present study, HAART-treated HIV-seropositive individuals (n=20) and seronegative healthy controls (n=22) underwent neuropsychological testing including HIV-sensitive standard tests of attention, visuospatial capabilities, psychomotor speed, memory, executive functions and language. A seropositive-novel task used to assess decision making, the Game of Dice Task (GDT), was also included. The GDT utilizes explicit, stable rules and has been shown to co-vary more reliably with executive functions than other decision making measures (e.g. Iowa Gambling Task - IGT). The few existing studies of decision making in HIV included more complex populations (e.g., comorbid substance abusers), exclusively used the IGT and had mixed findings. Results indicate neurocognitive performance consistent with previous studies of HAART-treated HIV-patients; patients were impaired in tests of executive functions and information processing speed. Decision making capabilities, as measured by the GDT, were significantly impaired in the HIV group. Furthermore, GDT deficits were also related to lower mood in a depression screen. This study shows that decision making capabilities are significantly altered in HIV-patients and such deficits relate to mood and executive functions.

E103

RISK TAKING AND TEMPORAL DISCOUNTING IN PARKINSON'S DISEASE Erin Kendall Braun[1], Karin Foerde[1], Bernd Figner[1,2], Elke Weber[1], Daphna Shohamy[1]; [1]Columbia University, [2]University of Amsterdam — Two factors that are known to substantially affect decisions are the tendency to take risks and the tendency to prefer immediate outcomes. Previous research has shown that both risk taking and temporal discounting are modulated by striatal dopamine, but questions remain about the causal role of dopamine in these behaviors. Parkinson's disease is characterized by a loss of dopaminergic inputs to the striatum, providing a model for testing the necessity of striatal dopamine in such processes. Here, to better understand the role of dopamine in risk taking and temporal discounting, we tested Parkinson's disease patients and healthy controls on two decision making tasks: one that assessed risk taking (the Columbia Card task) and one that assessed temporal discounting (the Intertemporal Choice task). In the Columbia Card task, we manipulated trial-by-trial the values of gain and loss cards and the probability of loss, and participants were asked to select a number of cards to maximize winnings. In the Intertemporal Choice task, participants chose between rewards that would be obtained at different points in time. We found that Parkinson's patients made riskier choices than controls. Moreover, unlike the controls, patients did not learn to decrease their risk taking as the experiment progressed. On the Intertemporal Choice task, we found that Parkinson's patients were more willing than controls to wait longer for larger rewards. Together with previous animal and human fMRI research, our results suggest that striatal dopamine contributes to the risk-related and temporal effects on decision making.

E104

STRATEGY UPDATING UNDER DIFFERENT REGIMES: KEEPING IT SIMPLE MAY BE THE BEST WAY Alex Filipowicz[1], Elisabeth Stöttinger[1], James Danckert[1], Britt Anderson[1,2]; [1]Dept. of Psychology, University of Waterloo, Canada, [2]Centre for Theoretical Neuroscience — We measured normal adults' ability to build and update a mental model by using the simple game Rock, Paper, Scissors (RPS). An important cognitive skill is the ability to update a mental model when it no longer accurately reflects environmental information. People with right brain damage (RBD) are impaired on this type of model updating. We had university undergraduates play a game of RPS against a computer opponent. After a preliminary period of selecting items uniformly, the computer switched to one of three strategies: "biased" play (computer selects one option 80% of the time), "one-ahead" (computer chooses item that beats participants' previous item selection 80% of the time), or "superstitious" (computer ensures that participants wins 80% of the time). After a predetermined number of trials the computer again switched strategy; all participants faced a biased play strategy (using a different item). Our results indicate that, the "biased" group were more successful than the "one-ahead" group at learning the computer's first strategy (only 40% of participants in the "one-ahead" group understood the strategy compared to 78% of participants in the "biased" group) and were subsequently quicker at adapting to the computer's play when the computer switched to its final strategy ($F(2) = 3.7$; $p < 0.05$). We conclude that the nature, and possibly the strength of a mental model has a significant influence on the ability to update that model. The impairment for statistical learning observed after RBD may explain the impaired ability of people with RBD to update mental models.

E105

USING THE BALLOON ANALOGUE RISK TASK (BART) TO EXAMINE NEURAL CORRELATES OF RISK-TAKING BEHAVIOR IN ADOLESCENTS Tracy Riggins[1], Kelsey Cacic[2], Betty Jo Salmeron[2], Pradeep Kurup[2], Thomas J. Ross[2], Carl Lejuez[1], Maureen Black; [1]University of Maryland, College Park, [2]National Institute on Drug Abuse, Intramural Research Program, [3]University of Maryland, Baltimore, School of Medicine — Adolescence is characterized by increased risk-taking behavior. The goal of the current study was to examine the neural mechanisms underlying decision making during risk (i.e., contemplation, anticipation, and reward) using a modified version of the Balloon Analogue Risk Task (BART) during which participants blow-up virtual balloons. Like real-world situations, risky choices are rewarded up to a point at which riskier choices result in poorer outcomes. Previous research has shown that riskiness on this task is correlated with established risk-related constructs (sensation seeking/impulsivity) and risky behaviors (smoking/stealing/sex, Lejuez et al., 2002). Preliminary behavioral results from 16 adolescents (mean age = 17 years + 1, range = 15-19) reveals considerable variability in behavioral performance. For example, the average number of pumps per balloon ranged from 17-68 (mean = 46) and the total number of exploded balloons ranged from 20-44 (mean = 31). After covarying for effects of age, preliminary fMRI results (n=11) demonstrate that contemplation (thinking about and selecting the number of pumps for a balloon) is associated with significant activation in left inferior frontal gyrus, bilateral thalamus, bilateral cingulate gyrus, right posterior cingulate, right parahippocampal gyrus, right substantia nigra, and right culmen ($p<.05$ corrected). Anticipation (waiting for the balloon to inflate) following a negative outcome (an "explosion" on the previous trial) is characterized by right insula activation compared to anticipation following a positive outcome (a previous "win" trial, $p<.05$ corrected). These findings illustrate differential neural mechanisms associated with contemplation and anticipation following negative outcomes in a simulated risk-taking task with adolescents.

E106

RESTING-STATE ANALYSIS OF THE VENTRAL TEGMENTAL AREA AND SUBSTANTIA NIGRA REVEALS DIFFERENTIAL CONNECTIVITY WITH THE PREFRONTAL CORTEX Maheen Shermohammed[1], Vishnu Murty[1], David V. Smith[1], McKell Carter[1], Scott Huettel[1], R. Alison Adcock[1]; [1]Duke University — Dopamine neurons of the midbrain have been demonstrated to play an integral role in a wide variety of cognitive processes, including motor planning, pursuit of reward, and retention in memory. The dopaminergic midbrain is traditionally divided into the ventral tegmental area (VTA) and the substantia nigra (SN), two areas that are separate in primates and rodents and known to have distinct projection targets and play distinct roles in behaviors. However, functional distinctions between these areas in humans are a subject of debate, and their functional connectivity has yet to be directly contrasted. The current study used resting-state fMRI to distinguish the functional connectivity patterns of the VTA and SN. Anatomical VTA and SN regions of interest (ROIs) were drawn on 50 individual subjects, from which 3mm kernels created at the bilateral centers of mass of each ROI were used as seed regions for whole-brain connectivity analysis. Group -level analysis revealed differential patterns of connectivity of the VTA and SN. Specifically, the SN (bilateral) showed greater functional connectivity than the VTA with the insula and motor cortex ($p < 0.05$, whole-brain corrected). The right VTA showed greater functional connectivity than the right SN with the right dorsolateral prefrontal cortex ($p < 0.05$, whole-brain corrected). These results show that the VTA and SN interact with distinct cortical networks, which in turn suggests dissociable roles for these anatomical regions in dopamine-dependent behaviors in humans.

E107

SELECTIVE REVERSAL LEARNING DEFICIT IN INDIVIDUALS WITH POST TRAUMATIC STRESS DISORDER (PTSD), BUT NOT GENERALIZED ANXIETY DISORDER (GAD) Einat Levy-Gigi[1], Mark A. Gluck[1], Szabolcs Keri[2,3]; [1]Rutgers University, Center for Molecular and Behavioral Neuroscience, Newark, USA, [2]University of Szeged, Faculty of Medicine, Szeged, Hungary, [3]National Psychiatry Center, Budapest, Hungary — A wide range of neuroimaging studies have demonstrated a diminished MTL activation and/or reduced hippocampal volume in individuals with PTSD. In a past study we found that PTSD participants show a hippocampus-dependent generalization deficit similar to individuals with amnesic Mild Cognitive Impairment (aMCI) and mild Alzheimer disease. The aim of the present study was to test whether this impairment can be specifically attributed to over-generalization of cue or context. 13 PTSD, 17 GAD and 20 healthy controls (HC) participants were tested on a novel cue-context reversal task. The acquisition phase of the task includes a discrimination learning procedure in which cards consisting of a cue and a context predict a specific outcome (reward or punishment). In the subsequent reversal phase, there are two possibilities: (1) the cue is unchanged but appears in a new context; (2) a new cue is presented in the original context. The new cards are associated with the opposite outcome relative to the cards in the first phase. Participants must reverse the original discrimination rule in order to adapt to the new condition. We found that all groups preformed equally well at the acquisition phase. Individuals with GAD performed similarly to HC on the reversal phase. However, individuals with PTSD showed a significant deficit to reverse from negative to positive feedback. This deficit was particularly strong in negative context. This deficit may reflect a dysfunction of the ventromedial frontal - amygdala system, explaining why PTSD individuals fail to reverse aversive context.

E108

DECISION MAKING IN OLDER ADULTS: THE INFLUENCE OF LEARNING ON A CUED PREDICTION TASK Kendra L. Seaman[1], Alissa Forman-Alberti[1], Darlene V. Howard[2], James H. Howard, Jr.[1,2]; [1]The Catholic University of America, [2]Georgetown University — Older people are increasingly being asked to make critical decisions regarding housing, personal finance, and healthcare, raising questions about the decision-making abilities of

older adults. In this study we use the Triplets Prediction Task (TPT) to investigate the relationship between learning and decision making in young and older adults. In the TPT, subjects see two successive visual cues and then predict which target will follow. Unknown to subjects, there is a predictive relationship between the first cue and the target such that each of four cues predicts one of four targets 85 percent of the time. Participants in both age groups demonstrated learning of the cue-target relationships through more frequent prediction of the most likely target for each cue, but young adults were significantly better at this prediction. In addition, only young adults demonstrated skill learning through faster responses over time. To examine how learning was associated with decision-making strategy, we compared the tendency to make varied predictions for each cue (exploration) to the tendency to stay with the same prediction (exploitation). This revealed a significant change in decision-making strategy over time, with subjects shifting from an exploratory strategy to an exploitative one as learning progressed. A marginally significant interaction between age and strategy suggests that this change in strategy is greater for young adults than older adults. Together, these analyses suggest that deficits in experiential decision making in older adults are related to deficits in learning.

E109

IMPROVED SELF-CONTROL WITH EXTENDED ABSTINENCE IN METHAMPHETAMINE DEPENDENCE Catherine Fassbender[1], Julie B Schweitzer[1], Kyle J Rutledge[1], Stefan Ursu[1], Ruth Salo[1]; [1]University California Davis Medical Center — Impulsivity and diminished self-control are thought to play important roles in addiction. Delay discounting (DD) paradigms measure impulsive decision-making relevant to addiction by presenting a series of choices between an immediate smaller monetary reward and a delayed, larger monetary reward. Numerous studies have found that addicted individuals display increased impulsivity (increased choice of immediate rewards) on DD paradigms. The goal of the current study was to investigate whether periods of abstinence ameliorated impulsivity in currently drug abstinent individuals with a history of methamphetamine (MA) dependence. Participants included 22 individuals with a history of MA dependence and 17 non-substance abusing controls, with ages ranging from 18 to 48 yrs of age. MA dependent subjects were required to be abstinent for at least 30 days and toxicology tests were conducted to confirm sobriety. Exclusion criteria included substance dependence other than MA within the past year and alcohol abuse/dependence within the past 5 years. Marijuana abuse was permitted in MA users. Controls were not permitted to have any history of substance/alcohol abuse/dependence. MA dependent subjects were significantly more impulsive than controls ($p<0.0001$). Correlations between number of months abstinent and impulsivity revealed that those participants with longer periods of MA drug abstinence were less impulsive ($r = -0.48$, $p = 0.03$). Dividing participants into short (<1yr) and long (>1yr) term abstinent revealed that those who were short- term abstinent were significantly more impulsive ($t = 2.37$, $p = 0.03$). These results suggest improvements in self-control and impulsivity with protracted drug abstinence.

E110

BRAIN SYSTEMS INVOLVED IN LEARNING TO AVOID PAIN Mathieu Roy[1], Daphna Shohamy[2], Nathaniel Daw[3], Tor Wager[1]; [1]University of Colorado, Boulder, [2]Columbia University, [3]New York University — The ability to predict and avoid potentially aversive outcomes is essential to our capacity to navigate through life with minimal suffering. While the use of computational methods to study learning has greatly advanced our understanding of appetitive reinforcement learning in humans, surprisingly relatively little work has taken advantage of these methods to study aversive or avoidance learning. Here, we used temporal-difference learning algorithms in combination with functional magnetic resonance imaging (fMRI) to identify the brain regions involved in pain avoidance learning during a continuous two-alternative probabilistic learning task. On each trial, participants (n = 22) had to select the alternative that yielded the lower probability of leading to a painful thermal stimulation. During the choice period, activity in the ventromedial prefrontal cortex (VMPFC) positively correlated with the probability of avoiding pain. These findings are consistent with VMPFC's role in the representation of the expected value of outcomes, as well as in the generation of "safety" signals. In addition, an aversive prediction error signal at the onset of painful stimulations was observed in the hippocampus, anterior and mid- cingulate cortex, medial prefrontal cortex and substancia nigra, suggesting that these regions integrate negative feedback to learn to avoid unpleasant outcomes. These regions are largely distinct from those involved in appetitive prediction errors, suggesting that the brain regions involved in avoidance learning are partially distinct from those involved in appetitive reinforcement learning.

Monday, April 2, 1:00 - 3:00 pm, Exhibit Hall

ATTENTION: Other

F1

ERP CORRELATES OF SHORT-TERM TRAINING AND SOA IN A DUAL-TASK PARADIGM Eric Ragusa[1], Fae Messier[1], Barry Haimson[1]; [1]University of Massachusetts Dartmouth — Prior research found that when the stimulus onset asynchrony (SOA) between Task 1 (T1) and Task 2 (T2) is very brief, the reaction time (RT) to T2 will be longer that it would be in a control condition without the presence of T1. Presumably this delay in processing T2 is due to a bottleneck in processing T1. This brief period of time has become known as the psychological refractory period (PRP). However, the RT to T2 is not reduced when the SOA is longer and falls outside the PRP interval. Other findings have suggested that extensive training may reduce the dual-task penalty incurred by the PRP, but this research has not evaluated the electrophysiological correlates of such training. The current study was designed to evaluate differences in ERP activity following training in a dual task paradigm with long and short SOA intervals. Subjects were randomly assigned to a continuous practice group without feedback or to a group which received a suggested task strategy with feedback for correct responses during part of the study. A preliminary analysis of the RT data indicated that both groups showed practice effects for long and short SOA conditions. Following practice P300 latency at frontal sites decreased for a short SOA, but increased for a long SOA. Changes in P300 peak amplitude data were also noted. These findings suggest that ERP components that precede behavioral responses may vary with training in different kinds of dual task paradigms.

F2

USE OF VISUAL AND HAPTIC VIRTUAL ENVIRONMENTS TO IMPROVE ATTENTION IN SEVERE TBI Assaf Y. Dvorkin[1,2], Amit Shah[3], Milan Ramaiya[3], Felise Zollman[1,2], Eric Larson[1,2], Nancy Hsu[1], Sonia Pacini[1], James L. Patton[1,2,3]; [1]Rehabilitation Institute of Chicago, [2]Northwestern University, [3]University of Illinois at Chicago — Several studies have demonstrated the efficacy of emerging technologies such as virtual reality (VR) and robotics as an assessment and intervention tool for a variety of neurological conditions. However, there is paucity of literature on the use of such technology in the traumatic brain injury (TBI) population, especially for attention rehabilitation. We have developed and tested an integrated VR-robotics paradigm for improving attention in early stages of recovery in severe TBI inpatients. 21 TBI inpatients participated in a 2-day study, in which they interacted with virtual environments that provided visual and haptic (sense of touch) feedback during a reaching task. A robotic device held by the patient's hand delivered either a "breakthrough" force (similar to popping a balloon), a gentle pulse of force - a haptic nudge, or no haptic force. Our findings showed that the technology was remarkably well-tolerated by almost all patients. Results further showed significant improvement with practice, and more surprisingly, from one day to the next, with a beneficial effect from the haptic cues. 11 new severe TBI inpatients participated in an ongoing 2-week study that included either incremental adjustment of VR task difficulty as patients improve, or standard attention training. Initial results indicated that nearly all patients tolerated the treatment by completing the entire protocol, exhibiting an overall improvement in performance. We propose that interactive VR-robotics attention exercises are well-tolerated and engaging and that they could be beneficial for inpatients with severe TBI. The study should provide a guide for future clinical trials.

F3

ATTENTION INFLUENCES THE NEURAL REPRESENTATION OF NATURAL SCENE CATEGORY Eamon Caddigan[1], Audrey Lustig[1], Li Fei-Fei[2], Diane Beck[1]; [1]University of Illinois at Urbana-Champaign, [2]Stanford University — Images of natural scenes are quickly and accurately categorized by human observers, even when visual attention is engaged by a demanding secondary task. Multivoxel pattern analyses (MVPA) have been used to show the presence of scene category information in scene-selective cortical areas (such as the parahippocampal place area, or PPA), and that this information is sensitive to manipulations that influence human behavior. Recent work has shown that objects in unattended natural scenes can be identified by patterns of fMRI activity. Here, we used MVPA to investigate whether spatial attention modulates the neural representation of scene categories. On separate runs, participants either detected repetitions in a stream of natural scenes or searched at fixation for predefined color-shape conjunction targets within a stream of small colored crosses superimposed on the scenes. Because the displays were identical in both conditions, this manipulation allowed us to measure the influence of observers' attentional focus on scene category decoding. We found that decoding accuracy in the PPA was reliably above chance in both conditions, showing that category information is represented in scene-selective cortex even when attention is directed elsewhere. However, correct classification rates were significantly higher when participants performed the task requiring attention to scenes. These results provide additional evidence that category information can be extracted from scene images under conditions of limited attention, but show an influence of attention on the perception of natural scenes.

F4

LOOKING AT FACES GUIDES SOCIAL PERCEPTION Julia Boggia[1], Jelena Ristic[1]; [1]McGill University — Faces play an important role in social cognition. Here we addressed the question of the role of face perception in segmentation of dynamic social information. Participants were asked to view a short movie clip and to segment it into 'social units' or 'nonsocial units' by pressing a key on the keyboard. This task results in a pattern of 'breakpoints' (e.g., Newtson & Enquist, 1976; Zacks et al., 2001), which reveal behavioral markers of the boundaries of the perceptual units and index the underlying perceptual parsing processes. We recorded the number of each participant's key presses and measured their eye movements using a remote infrared eye tracker. Our data revealed that the pattern of breakpoints and associated eye movements differed across the two instructional groups in three important ways. First, the group that received the instructions to segment the clip into social units showed higher inter-subject response agreement. Second, 'social' perceptual

units relative to 'nonsocial' units, contained significantly more images of close up faces. Finally, the patterns of eye movements differed across the two groups. Surprisingly, participants looked longer at faces when they performed 'nonsocial' relative to 'social' unit segmentations. Together these data indicate that the basic unit marking procedure reveals important properties of social perception and strongly suggest that faces convey key information needed for parsing and understanding of dynamic and complex social events.

F5

A GRAPH THEORETIC APPROACH TO NETWORK-LEVEL FUNCTIONAL BRAIN MAPPING: SYSTEMATIC DIFFERENCES IN FUNCTIONAL ARCHITECTURE OF THE ATTENTION NETWORK ARE LINKED TO SPECIFIC PATTERNS OF STRATEGIC ATTENTIONAL CONTROL. Christine M. Tipper[1], Dani S. Bassett[1], Mason A. Porter[2], Elissa Aminoff[3], Arianne Johnson[1], Amy Frithsen[1], Michael Datko[4], Michael B. Miller[1], Scott T. Grafon[1]; [1]University of California, Santa Barbara, [2]University of Oxford, [3]Carnegie Mellon University, [4]University of California, San Diego — A brain network distributed throughout frontal and parietal cortex mediates the strategic control of attention. How this network carries out various processes that comprise the attention system remains unclear, owing in part to tremendous variability in how multiple attentional processes are engaged between individuals, over time, and across tasks. The present study leveraged this variability using a graph-theoretic approach to identify links between systematic differences in the functional architecture of the attention network and individual differences of performance on a challenging strategic attentional control task. While undergoing fMRI, 115 participants discriminated bilateral stimulus displays for the presence or absence of a target. A pre-cue provided two pieces of information: the likelihood of the target's presence and its likely location. Participants varied in how they utilized this information and whether they updated control strategies dynamically based on changing contingencies. Time-varying BOLD activity was extracted from 51 regions defining the attention network, and a functional brain graph was constructed for each scanning run by correlating BOLD activity between each node pair. Modularity maximization algorithms identified functional modules within the attention network that varied systematically across individuals. Individuals sharing a similar modular structure were grouped using a data-driven clustering method, revealing four distinct attention network architectures. Each of these network structures was linked to a specific pattern of behavioral performance, varying in both strategic flexibility and perceptual sensitivity. The results demonstrate the utility of this data-driven approach for explaining differences in cognition with respect to the functionality of underlying complex brain networks.

F6

PERCEPTUAL LEARNING FACILITATED BY EXOGENOUS ATTENTION AND DYNAMICS OF ACTIVATIONS IN EARLY VISUAL AREAS Penelope Papalambros[1], Ikuko Mukai[1], Masaki Fukunaga[2], John E. Ingeholm[1], Leslie G. Ungerleider[1]; [1]National Institute of Mental Health, [2]Osaka University — Perceptual learning is the phenomenon in which repeated experience with visual stimuli results in improvements in perception of these stimuli. Our previous psychophysical results (Mukai et al., 2011) suggested that both exogenous attention and endogenous attention facilitate perceptual learning, but that these two types of attention may be mediated by different neural mechanisms. To explore the neural mechanisms by which exogenous attention affects perceptual learning we conducted an fMRI study. During training, subjects (n=14) were cued exogenously to allocate three different levels of attention (attended, divided-attended and unattended) to four different stimulus locations and indicate the orientation of a Gabor patch. Subjects underwent fMRI sessions before and after training to compare changes in BOLD signals to passively viewed Gabor patches, as did controls (n=8) who had no training. We replicated the behavioral results obtained in Mukai et al. (2011): A significant reduction in contrast thresholds for the attended (p=0.005), but not for divided-attended or unattended locations, even though accuracy increased during training for the attended (p=5.0x10-4) and divided-attended (p=6.5x10-6) locations. The fMRI results of a paired t-test on group ROI data revealed significantly greater activation during post-training than during pre-training sessions for the attended location (p=0.034). On the other hand, no significant changes were found in the fMRI data for the divided-attended or unattended locations, or for control subjects (p>0.05). The results suggest that enhanced behavior at attended locations correlate with increased activation in the early visual areas responsible for the stimulus processing.

F7

EVENT-RELATED POTENTIALS REVEAL THE EFFECTS OF ATTENTION ON EMOTICONS PROCESSING Shichun Guo[1], Shimin Fu[1]; [1]Tsinghua University — Emoticons consist of punctuations and English letters and similar to faces, have simple facial expressions. Previous studies have shown that attention may modulate the processing of faces, but only few studies have been conducted to investigate whether the processing of emoticons can be modulated by attention. In the present study, Event-related potentials (ERPs) were recorded when participants performed an orientation discrimination task in a central cueing paradigm. Emoticons were presented to the left or right visual field. Prior to the onset of the emoticons, a central cue was presented. The cue predicted the location of subsequent emoticons in 75% of trials. Participants were required to respond to the orientation (upright or inverted) of the designated targets (20% of total trials) in each block. Behavioral data show that participants responded faster to valid relative to invalid trials. ERP results show that valid trials elicited a larger P1 (100-140 ms) and smaller P2 (204-256 ms) and smaller P3 (324-378 ms) relative to the invalid trials. An inversion effect of emoticons was observed at 156-166 ms for valid trials, but not for invalid trials. Results suggest that emoticons show inversion effect at approximately 160 ms when attended, and attention can modulate the process of emoticons at an early processing stage, approximately 120 ms after stimulus onset.

F8

CUE REACTIVITY TO DRUG IMAGES IN RECREATIONAL STIMULANT USERS: AN EVENT-RELATED POTENTIALS STUDY John Erik Vanston[1], Natalie Ceballos[1], Schepis Ty[1], Reiko Graham[1]; [1]Health Psychophysiology Lab, Department of Psychology, Texas State University — The ability for drug-related cues to capture attention in drug-dependent individuals has been well-documented. In contrast, cue reactivity in recreational users requires elucidation. We examined the neurophysiological correlates of stimulant-related attentional processes among recreational stimulant users using a 3-stimulus oddball paradigm. Participants (N = 20, 9 males and 11 females, mean age = 20.1) completed two versions of the task: one where they responded to stimulant targets (respond to stimulant pictures, ignore other objects or nonsense shapes) and another where they responded to object targets, while event-related potentials were measured. Task order was counterbalanced across participants. Analyses focused on the parietal P300, which was maximal approximately 350-450 ms after stimulus onset. P300 amplitudes were larger for stimulant images and targets. These main effects were mediated by a target by condition interaction. Post hoc analyses revealed no significant difference between object targets and drug non-targets in the object condition, suggesting that drug images captured attention, regardless of target status. In addition, enhanced amplitudes as a function of target status were larger for drugs than for objects. Overall, results suggest that drug images capture attention via the synergistic interaction of controlled and automatic processes. Further research is required to determine whether cue reactivity in the form of enhanced P300 amplitudes to stimulant images is the result of learning via cultural influences, drug attitudes or experience.

F9

RESTING STATE EEG OSCILLATORY POWER DIFFERENCES IN ADHD COLLEGE STUDENTS AND THEIR PEERS Steven Woltering[1], Jessica Jung[1], Zhongxu Liu[1], Rosemary Tannock[1]; [1]University of Toronto — Attention-deficit/hyperactivity disorder (ADHD) in children is characterized by elevated levels of slow oscillatory activity and reduced fast oscillatory activity in resting-state electroencephalogram (EEG). In adults with ADHD, resting-state EEG findings are scarce and inconsistent. The present study examined adult college students with ADHD, and a comparison group in a resting-state condition. Twenty adults with ADHD and 16 control adults are currently analyzed for the study. The EEG results confirmed the hypothesis that reduced levels of relative alpha power, and increased levels of relative theta power, were associated with ADHD. No group differences were found for relative beta power. These findings demonstrate similar neural signatures in adults and children, confirming oscillatory power in theta and alpha bands as biomarkers for ADHD throughout development.

F10

LEFT SPATIAL NEGLECT PATIENTS ALSO NEGLECT THE LEFT (PAST) SIDE OF TIME Arnaud Saj[1], Orly Fuhrman[2], Patrik Vuilleumier[1], Lera Boroditsky[2]; [1]Department of Neurology and Neurosciences, University Hospital of Geneva, University of Geneva, Switzerland, [2]Department of Psychology, Stanford University — Previous research suggests people construct mental timelines to represent and reason about time. However, are spatial representations truly necessary for representing events in time? Our results show for the first time that deficits in spatial representation (as a function of left hemi-spatial neglect) also result in deficits in representing events along the mental timeline. Specifically, we show that patients with left hemi-spatial neglect have difficulty representing events that are associated with the past and thus fall to the left on the mental time-line. These results demonstrate that representations of space and time share neural underpinnings and that representations of time have specific spatial properties (e.g., a left and a right side). Further, it appears that intact spatial representations are necessary for at least some types of temporal reasoning.

ATTENTION: Spatial

F11

ERP MANIFESTATIONS OF KNOWLEDGE-BASED ATTENTION-SPREADING: EFFECTS OF LEXICALITY ON ATTENTIONAL SELECTION Yasuko Okumura[1], Tetsuko Kasai[1], Ryuji Takeya[1], Harumitsu Murohashi[1]; [1]Hokkaido University — Attention spreads across two stimuli with perceptual grouping factors like connectedness, which can be observed as reduced lateralized spatial attention effects in event-related potentials (ERPs). In this study, ERP manifestations of knowledge-based attention-spreading were explored using Hiragana letter strings. ERPs were recorded from 12 native Japanese speakers. Stimuli were Japanese words, nonwords, and reversed words, consisted of four characters aligned horizontally across the left and right hemifields. Participants were instructed to attend either left or right end of the rapidly presented stimuli and to detect target characters appearing infrequently at the attended hemifields. ERPs to the standard stimuli at the occipito-temporal electrodes (PO7, PO8) revealed the greatest attention effects varying among the stimulus conditions. Modulation of the attention effects was clarified on difference waves between ERPs for attending to the contralateral and ipsilateral hemifields, with respect to the hemispheres. In the N1 latency range (160-210 ms post-stimulus onset), the attention effect for words was significantly more positive than those for nonwords and reversed words. It indicates that attention spread from an attended location toward the opposite side of the stimuli most prominently in words. Furthermore, differential attention effects between words and reversed words suggest that ordinary spatial arrangement, rather than combination, of characters plays an important role in attentional guidance, since reversed words are correct in terms of the combination. As a conclusion, we identified attention-spreading based on lexical knowledge, with N1 as its ERP correlate. This finding may be beneficial for to understand how we integrate letters into words.

F12

AN EXAMINATION OF LONG-TERM MEMORY GUIDANCE OF VISUAL SPATIAL ATTENTION TO MULTIPLE LOCATIONS Maya L. Rosen[1], Stephanie L. Bachewski[1], Chantal E. Stern[1], David C. Somers[1]; [1]Boston University — Using a variant of a change-detection task, this experiment sought to examine whether long-term memory can influence spatial attention to multiple locations. Twenty-nine participants were trained on a change-detection flicker paradigm with complex visual scenes that contained 0, 1, 2, or 3 changes at different spatial locations. During the test phase, a previously studied scene was presented statically and subjects were instructed to covertly direct their attention to the location(s) where they remembered a change had occurred during the study phase. The scene would then reappear, and participants responded with a two-alternative forced choice whether or not they detected a change (Change, No change). Scenes had a 50% chance of containing a single change. The changes were those previously studied, except for the images where no change occurred during the study phase; those changes were necessarily novel. Results indicate that d′ significantly increased in conditions where there were studied changes compared to when no change was previously studied. Furthermore, k-score significantly increased in the multiple-change conditions (2 or 3 studied changes) compared with the single change condition. Together, these findings suggest memory and attentional systems interact such that long-term memory can be used to direct visual spatial attention to multiple locations based on previous experience. This experiment links studies indicating that people are better at directing their attention when they have studied a scene (Summerfield et al., 2006, 2011) and studies demonstrating that people are capable of attending to multiple locations simultaneously (McMains and Somers, 2004, 2005).

F13

UNEXPECTED SHIFTS OF COVERT SPATIAL ATTENTION ARE LINKED TO A CHANGE OF FUNCTIONAL CONNECTIVITY BETWEEN KEY REGIONS OF THE DORSAL AND VENTRAL ATTENTION NETWORKS Jérôme Prado[1,2], Daniel Weissman[3]; [1]Centre National de la Recherche Scientifique, Laboratoire sur le Langage, le Cerveau et la Cognition, [2]Université de Lyon, [3]University of Michigan — When spatial attention must unexpectedly be directed to a new location, a ventral attention network that signals the need to reorient spatial attention is thought to dampen activity in a dorsal attention network that maintains the current attentional focus. However, evidence to support this view is scarce. To investigate this hypothesis in the present study, we asked fourteen healthy adults to perform a covert visual spatial attention task, which involved discriminating the orientation of a letter in the cued visual field (valid trials) or, occasionally, the uncued visual field (invalid trials), while we recorded their brain activity using fMRI. Replicating prior work, the ventral attention network was more highly activated in invalid than in valid trials. Further, as hypothesized, functional connectivity analyses revealed that a change of activity in the right inferior frontal gyrus, a critical node of the ventral attention network, was linked to a smaller change of activity in key regions of the dorsal attention network in invalid than in valid trials. These findings provide novel support for the view that the ventral attention network dampens activity in the dorsal attention network during unexpected shifts of visual spatial attention.

F14

THE EFFECTS OF IGNORED VERSUS FOVEATED CUES UPON INHIBITION OF RETURN AND EARLY EVENT-RELATED POTENTIAL COMPONENTS TO TARGETS CALLING FOR MANUAL LOCALIZATION RESPONSES Jason Satel[1], Matthew Hilchey[1], Ross Story[1], Zhiguo Wang[2], Raymond Klein[1]; [1]Dalhousie University, [2]Chinese Academy of Sciences — Using 24 different variations of Posner's cue-target paradigm, Taylor & Klein (2000) discov-

ered two mutually exclusive "flavors" of IOR: When the oculomotor system is inhibited, IOR affects input processes (perception/attention flavor); when the oculomotor system is not inhibited, IOR affects output processes (motor flavor). Studies of brain activity with ignored cues and manual responses to targets (for a review, see Prime & Ward, 2006) have typically reported that IOR reduces an early, sensory component (P1) of the brain's response to the target. Since eye movements are discouraged in these experiments, this P1 reduction might be a reflection of the perception/attention flavor of IOR. If, instead of ignoring the cue, participants make a prosaccade to the cue (and then return to fixation) before making a manual response to the target, then the motor flavor of IOR should be generated. In the present study we compared these two conditions while monitoring eye position and recording ERPs to the targets. If the P1 modulation is related to IOR, there should be no IOR modulation of the P1 component when the motoric flavor of IOR is generated by a prosaccade to the cue. Whereas target-elicited P1 reductions were similar, and behavioral IOR significant, in both conditions, behavioral IOR was significantly larger in the saccade condition. These findings suggest that either: 1) perceptual/attentional mechanisms of IOR are recruited whether the oculomotor system is inhibited or activated, or 2) P1 reductions do not provide an accurate reflection of IOR's behavioral manifestation.

F15

NEURAL CORRELATES OF SPONTANEOUS FLUCTUATIONS IN ATTENTIONAL CONTROL Anthony Sali[1], Steven Yantis[1]; [1]Johns Hopkins University — Spontaneous fluctuations in task engagement are associated with variation in cognitive flexibility, which is required for shifting task set. These fluctuations are associated with corresponding changes in brain activity that can be used to predict moment-by-moment changes in behavioral performance. We used fMRI to investigate the neural correlates of spontaneous fluctuations in readiness to covertly shift attention between two peripheral rapid serial visual presentation (RSVP) streams. Participants attended to one of two continuously present streams; following the appearance of a shift or hold cue in the attended stream, they shifted (or held) attention and responded to a target in the newly (or still) attended stream. Target detection RT following a shift or hold served as a behavioral index of fluctuations in attentional flexibility (readiness to shift attention) or stability (successfully holding attention). Covert shifts of attention were associated with transient activity within bilateral medial superior parietal lobule (mSPL) and with retinotopic modulations of activity within extrastriate cortex. We used linear regression to predict response time on each trial from pretrial BOLD activity. High pretrial activity within mSPL was associated with fast RTs for shift trials and slow RTs for hold trials; in contrast, high pretrial activity in default network structures was associated with fast RTs on hold trials but slow RTs on shift trials. Individual differences in fluctuating states of cognitive flexibility provide an index of the control of attention that may provide some insight into disorders of cognitive control as well as variability in attentional control in healthy individuals.

F16

ATTENTIONAL RESOURCES AND STIMULUS COMPETITION WITHIN AND ACROSS VISUAL HEMIFIELDS Sabrina Walter[1], Cliodhna Quigley[1], Matthias M. Mueller[1]; [1]University of Leipzig — A long-standing controversy in the field of attention revolves around the question of resource distribution between and within cortical hemispheres. One side favours two distinct attentional processing systems (different hemifield advantage), the other supports a common resource for both hemispheres. Earlier studies demonstrated better performance when attention was split across visual hemifields than within one hemifield, whereas results regarding spatial resolution in the upper vs. lower visual field are conflicting. We presented LEDs in each visual quadrant that flickered at different frequencies, thereby eliciting a distinct steady-state visual evoked potential (SSVEP) in the measured EEG. SSVEPs are robust brain-signals that oscillate at the same frequency as the driving stimulus and are amplitude modulated with attention. Subjects attended to two of the LEDs, located either within or across hemifields and performed a luminance-matching task at the to-be-attended locations. We found significant attentional modulations of SSVEP amplitude in the "attend-across" but not in the "attend-within" hemifield conditions. However, we found no SSVEP amplitude differences in the upper vs. lower visual field comparison. Behavioural data matched electrophysiological findings with faster reaction times in the "across" situation. Results thus support the "different hemifield advantage".

F17

FEATURE SIMILARITY GUIDES SPATIAL ATTENTION REGARDLESS OF OBJECT UNITY Ryuji Takeya[1], Tetsuko Kasai[1]; [1]Hokkaido university — The visual scene involves various Gestalt principles, which guide attention to task-irrelevant spatial regions within an object or a group. However, it is unknown how attention is guided when two principles are combined. The present study examined the case of connectedness and feature similarity across elements, by using event-related potentials (ERPs). Stimuli consisted of bilateral two elements (rectangles for standards; rounded rectangles for targets). Stimulus conditions involved orthogonal combinations of connectedness [connected (C+), unconnected (C-)] and size-similarity [similar (S+), dissimilar (S-)]. ERPs were recorded from 10 participants who were covertly attending to one hemifield while ignoring the other during rapid stimulus presentations. The task was to press a button for infrequent targets at the attended hemifield. The typical ERP attention effects (i.e., amplitude enhancement at occipital-temporal electrode sites contralateral to the attended visual fields) were assessed. Reduced P1 and N1 attention effects (85-115 ms and 130-190 ms post-stimulus onset, respectively) were observed for the connected condition compared to the unconnected condition, regardless of size-similarity. Reduced N2 attention effect (210-290 ms) was observed for the size-similar condition compared to the size-dissimilar condition, regardless of connectedness. These results indicate that attention is independently guided by objects or groups that are defined by different feature dimensions which is similar to the framework of saliency-map model. Furthermore, the result of object-based P1 attention effect was earlier than previously reported (N1), which suggests that task-difficulty and/or stimulus-context affect object-based spatial selection.

F18

REDUCED SEVERITY OF SPATIAL NEGLECT WHEN THE RIGHT-SIDED LESION EXTENDS INTO THE SOMATOSENSORY CORTEX Daniela Balslev[1,2], Hans-Otto Karnath[2]; [1]Center of Neurology, University of Tübingen, [2]School of Psychology, University of Copenhagen — Lesions in the right hemisphere lead often to spatial neglect. Voxel-based lesion behaviour mapping (VLBM) has identified the inferior parietal, superior and middle temporal as well as inferior frontal areas as being critically involved with a deficit of spatial orienting in the acute phase of the stroke. A hallmark feature in these patients is a sustained deviation of their eyes to the right. On the other hand, studies with healthy volunteers have revealed brain sites that affect the prioritization of the visual space, e.g. the frontal eye field, intraparietal sulcus or anterior parietal cortex. In particular, in an eye proprioceptive area in the anterior parietal cortex, a reduction of excitability induced by repetitive transcranial magnetic stimulation (rTMS) shifts perceived eye position towards the center of the orbit and causes a bias in visual sensitivity in the same direction, e.g. improves detection in the left vs. right hemifield when the gaze is directed rightwards. Because these brain sites are sometimes co-injured with the critical neglect areas after a middle cerebral artery insult, we investigated using VLBM whether their lesioning may exert a modulatory effect on the lateralized orientation bias. In subjects with lesions covering critical neglect areas we found that milder neglect in the acute stage of the stroke was correlated with lesions that extended into the anterior parietal cortex (BA1 and 2). Based on previous observations in healthy subjects, the mechanism of this modulatory effect of a reduced somatosensory processing may be an alteration in the proprioceptively signaled eye position.

F19

EFFECTS OF TASK DIFFICULTY ON THE RELATIONSHIP BETWEEN INDIVIDUAL DIFFERENCES IN PERFORMANCE AND BRAIN ACTIVITY DURING A VISUAL SEARCH TASK Eunjoo Kang[1], Kwang Ki Kim[2]; [1]Kangwon National University, [2]Dongguk University — Our goal was to identify brain regions associated with individual differences in reaction time (RT) during a visual search task (VST) that employed one target and seven distractors in a radial array. Target location, associated with 8 different fingers and keys was reported by pressing the appropriate key. fMRI data (1.5T, TR = 3s) were obtained from 22 normal right-handed young individuals during the VST and a sequential-motor task (SMT) that required the same motor response. Three versions of the VST varied in difficulty: one efficient, and two inefficient with different degrees of perceptual difficulty. The easy-efficient VST and the SMT resulted in the highest accuracy and shortest RT, with no individual differences related to brain region. The easy-inefficient (intermediate difficulty) VST resulted in good accuracy, but a longer RT that was positively correlated with anterior cingulate activity level across individuals. This correlation may be explained by the known involvement of anterior cingulate in online monitoring: i.e., more intense monitoring prolonged RT. During the difficult-inefficient (highest difficulty) VST, on average the lowest accuracy was found with the longer RT (mean RT was the same as for the easy-inefficient task). As for individual differences, however, RT was negatively correlated with activity level in the left inferior parietal region. This correlation during the difficult VST, where demands of attentional resources for perceptional processing was greatest, is possibly related to individual differences in efficiency of spatial action mapping, which is thought to be one role of the inferior parietal cortex (supported by M10644020002-08N4402-00210).

F20

BIAS IN THE SPATIAL DISTRIBUTION OF ATTENTION Jing Feng[1], Ian Spence[2]; [1]Rotman Research Institute, [2]University of Toronto — Spatial bias in performance exists in a variety of cognitive tasks. Such bias has been attributed to possible bias in the spatial distribution of attention. We examined whether attention is biased toward certain visual areas using an Attentional Visual Field task. Participants' ability to detect a target among distractors was assessed at various locations across an extended visual area. Performance in target detection was compared between the upper half and the lower half of the visual field, as well as between the left half and the right half. Our data suggest that the spatial distribution of attention is indeed asymmetrical. In the vertical direction, attention is biased toward the upper half of the visual field. In the horizontal direction, attention is biased toward either the left half or the right half of the visual field, and individuals differed in the direction of this bias. Men in general had a rightward bias while women had a leftward bias. These findings confirm that bias exists in the spatial distribution of attention, suggesting that this attentional bias may be a contributing factor to the bias observed in perceptual and memorial tasks. Further research may explore the underlying neuropsychological mechanisms of the attentional bias and the individual difference in such bias.

F21

WHEN SPATIOTOPIC AND RETINOTOPIC COORDINATES ARE DISSOCIATED, IOR IS PRIMARILY SPATIOTOPIC, WHILE P1 REDUCTIONS ARE PRIMARILY RETINOTOPIC Matthew Hilchey[1], Jason Satel[1], Zhiguo Wang[2], Ross Story[1], Raymond Klein[1]; [1]Dalhousie University, [2]Chinese Academy of Sciences — Although the visual coordinate system is initially retinotopic, it has long been known that the representation of IOR can be observed in spatiotopic coordinates when an eye movement is made between the cue and a target calling for a manual response (Posner & Cohen, 1984; Maylor & Hockey, 1985). Neuroimaging studies using event-related potentials (ERPs) have generally revealed that early sensory components (P1) are reduced by IOR (for a review, see Prime & Ward, 2006). All such studies, to date, have confounded retinotopic and spatiotopic reference frames. In Experiment 1 we investigated whether the target-elicited P1 component would be modulated by IOR while we unconfounded these reference frames by interposing an eye movement between cue and a target calling for a manual response. With seemingly conflicting results, recent behavioral studies have investigated the frame of reference for IOR using saccadic responses to targets (Mathot & Theeuwes, 2010; Pertzov, Zohary & Avidan, 2010). Experiment 2 seeks to determine whether oculomotor IOR is spatiotopic (Pertzov et al.) or retinotopic (Matthot & Theeuwes) immediately following an intervening eye movement. In Experiment 1, P1 reductions at the cued location were greater in retinotopic, than spatiotopic, coordinates even though IOR showed the reverse pattern. Similar behavioral results (stronger spatiotopic IOR) were obtained in Experiment 2 when probed with eye movement responses. These results show that immediately after a saccade IOR is coded in spatiotopic coordinates and that the magnitude of P1 reductions does not provide an accurate reflection of IOR's behavioral manifestation.

F22

SELECTIVE ATTENTIONAL EFFECTS BASED ON THE PREDICTIVE VALUE OF A SPATIAL CUE Katherine E. Burnett[1], Giovanni d'Avossa[1], Ayelet Sapir[1]; [1]Bangor University, UK — We previously showed that attention could be selectively oriented to features based on the information provided by a spatial cue. In a dual-task with a random-dot kinematogram (RDK) in each quadrant of the screen, participants were asked to discriminate the direction of moving dots in one RDK and to localize one red dot. An endogenous spatial pre-cue was 70% valid for the location of only one target, and we found a validity effect only for the task for which the cue was informative. The present experiments were designed to investigate the conditions in which attention does not generalize to all features at the cued location. Participants reported the direction of translating dots in one RDK, as in the previous study, but now had to determine whether the color change of dots across one entire RDK was red or green. An endogenous spatial pre-cue was 70% valid for the location of one target, and provided no information about the location of the second target. Based on our previous findings we expected a validity effect only for the task for which the pre-cue was informative. We found validity effects for both tasks, though the magnitude of the effect was seemingly modulated by the informativeness of the cue. In conclusion, when more than one target is presented in the cued location, attention selectively biases performance based on the informativeness of the cue.

EMOTION & SOCIAL: Emotion-cognition interactions

F23

ACUTE STRESS IMPAIRS THE COGNITIVE REGULATION OF CONDITIONED FEAR Candace Raio[1], Temidayo Orederu[2], Laura Palazzolo[1], Elizabeth Phelps[1]; [1]New York University, [2]Hunter College — Cognitive regulation strategies, such as reappraisal, can modify emotional responses to signals in the environment by deliberately changing the way in which a stimulus or situation is interpreted. Real-world situations that call for us to exert such regulatory strategies, however, are often accompanied by stress. The same neural regions (i.e., dorsolateral and ventromedial prefrontal cortex) implicated in cognitive regulation are those that are selectively impaired by stress, suggesting that stress may diminish our ability to employ such strategies precisely at the time they're needed most. We examined this possibility using a fear-conditioning paradigm in which one conditioned stimulus (CS+) was occasionally paired with a mild wrist-shock, and another (CS-) was never paired with shock. Skin conductance responses (SCR) were recorded and served as our index of fear arousal. After conditioning, participants underwent a cognitive restructuring session where they learned to reappraise each CS and reinterpret the conditioning session in a more positive, less threatening manner. The next day, participants returned and underwent either an acute stressor (Stress group) or a control task (No-Stress group) before repeating the conditioning session from day 1. The efficacy of the stress induction was

established by observing significant increases in cortisol relative to baseline for the Stress group only. While conditioned responses to each CS diminished significantly on day 2 in the No-Stress group, responses within the Stress group showed no such attenuation, suggesting that stress impairs the ability to deploy cognitive regulation strategies.

F24

THE EFFECTS OF TRAIT ANXIETY AND STATE ANXIETY ON WORKING MEMORY SYSTEM Xuebing Li[1], Pengfei Xu[2]; [1]Key Laboratory of Mental Health, Institute of Psychology, Chinese Academy of Sciences, [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University — The major aim of the present study is to clarify previous inconsistent results of the effects of anxiety on spatial and verbal WM system by ERP technique. Participants were screened using the State-Trait Anxiety Inventory. Sixteen students (scores >46) were invited as high trait-anxious subjects, and sixteen students (scores<35) were invited as low trait-anxious subjects. During the experiment, participants were asked to perform four tasks (spatial 0- back task, spatial 2-back task, verbal 0-back task, and verbal 2-back task) under the fear and neutral emotion states. The emotional states were induced by watching horrible or documentary film clips before each task. ERP results showed that in low load 0-back task, there were no group effect or interaction effect between group and other factors for parietal P300 amplitude. In both groups, P300 amplitude reduced under the fear state. In high load 2-back task, there were significant emotion main effect and interaction effect between group and task type. Further analysis showed that high anxiety group had reduced P300 in spatial WM task in both emotional states, relative to low anxiety group. While, such effects were not observed in verbal WM task in both emotional states. These results suggested that the effects of anxiety on working memory system were modulated by task load and memory type. High anxious individual had more severe dysfunction on spatial WM than verbal WM, which is possibly due to the fact that anxious mood takes up visuospatial attention resource, and the resource is distinctly demanded in spatial WM.

F25

DEFAULT MODE NETWORK ACTIVITY INVOLVEMENT IN SOCIAL COGNITION: EMPATHY AND SEX DIFFERENCES. Margot Crossman[1], Joe P. Levy[1]; [1]University of Roehampton — The Default Mode Network (DMN) comprises a number of cortical and limbic regions that are temporally correlated at rest and is involved in introspective and self-referential processes. Altered functional connectivity in DMN has been identified in psychopathologies such as anxiety and depression and in the autism spectrum disorders. There is increasing evidence for a role for the DMN in social cognition and it has been shown that the extent of an individual's response to another's pain predicts DMN activity. The current study was undertaken to determine whether individual differences in social cognition in the typical population predict DMN activity. DMN activity was investigated in short resting fMRI scans of 53 healthy individuals using independent component analysis (ICA), a multivariate data-driven method that extracts statistically independent temporally coherent networks. Activity in separate DMN regions was correlated with the interpersonal reactivity index (IRI), a psychometric instrument consisting of four subscales each of which taps a separate aspect of empathy. Activation in the right temporoparietal junction positively correlated with the personal distress scale, a measure of anxiety and discomfort resulting from observing another individual's negative experience. Results also revealed sex differences within DMN regions, with females having greater activation in posterior regions (right cingulate and left parahippocampal gyrus) and males greater activation in frontal areas (right superior and medial frontal gyri and in the left middle frontal gyrus and cingulate gyrus). These results provide further support for a role of the DMN in social cognition.

F26

NEURAL BASES OF THE URGE TO IMITATE Sugiko Hanawa[1], Motoaki Sugiura[1], Takayuki Nozawa[2], Hiroshi Hashizume[3], Yukihito Yomogida[4], Yoritaka Akimoto[1], Yuka Kotozaki[2], Mizuki Ihara[2], Ryouichi Yokoyama[1], Ryuta Kawashima[1,2,3]; [1]Department of Functional Brain Imaging, IDAC, Tohoku University, Sendai, Japan, [2]Smart Ageing International Research Center, IDAC, Tohoku University, Sendai, Japan, [3]Division of Developmental Cognitive Neuroscience, IDAC, Tohoku University, Sendai, Japan, [4]Tamagawa University Brain Science Institute, Tokyo, Japan — Imitation is an inherent ability in humans. Although many studies have focused on human imitation skills, little research has been carried out on the neural mechanisms of spontaneous imitation. Using functional magnetic resonance imaging (fMRI), we investigated the neural bases of "the urge to imitate", which is closely linked to spontaneous imitation. First of all, we prepared about 200 movie clips of different meaningless hand actions. We created an inventory for the degree of urge to imitate and identified confounding factors based on the preparatory experiment of evaluating the impression of movie-clips. In addition to the urge to imitate, three confounding factors, "familiarity", "difficulty (to execute)", and "rhythm", were identified. We selected 24 movie clips so that the degree of the urge to imitate was varied. We presented the subjects with the movie clips and the subjects observed and imitated the hand movements during MRI scanning. We searched for cortical regions where the amplitude of neural response correlated with the degree of the urge to imitate or with confounding factors, respectively. We identified these regions and we found the right cingulate motor area (right CMA) showed a significant correlation with the urge to imitate without any confounding factors effects under the imitation condition only ($p<0.001$, corrected to $p<0.05$ using the cluster size) ($t=4.02$ at peak voxel). Our results show that the right CMA is indeed crucially involved in the neural mechanism of the urge to imitate.

F27

ACTIVITY IN THE CORRUGATOR SUPERCILII MUSCLE AS A NOVEL INDEX OF PUNISHMENT-GUIDED COGNITIVE CONTROL Björn R. Lindström[1,2], Isak Berglund Mattsson-Mårn[1], Armita Golkar[1,2], Andreas Olsson[1,2]; [1]Department of Clinical Neurosciences, Karolinska Institutet, Stockholm, Sweden, [2]Stockholm Brain Institute — Cognitive control is needed when mistakes have consequences, especially when such consequences are potentially harmful. However, little is known about how the consequences of deficient control guide behavior. In the present study, participants performed a two-choice response time task, where error commissions were expected to be punished by electric shocks. By parametrically and independently vary (1) the expected number of shocks (safe, low, high) associated with error commissions, and (2) cognitive control demands (low, high), we show that punishment-guided behavior is improved relative to safe conditions, especially during high control demands. We measured rapid event-related activity in the corrugator supercilii (CS) muscle of the upper face, which is controlled by midcingulate cortex (MCC) and known to be sensitive to negative affect, pain and cognitive effort. The CS amplitude was predictive of trial-to-trial behavioral accuracy and uniquely sensitive to the interaction of high punishment-expectancy and high cognitive control demands. Moreover, the CS mimicked the hallmark index of performance monitoring, the Error-Related Negativity (ERN) ERP component, elicited by performance errors. The CS amplitude was enhanced directly after error commissions, particularly during the high punishment-high control condition. In addition, error-related CS activity was related to compensatory behavioral adjustments, e.g. post-error slowing, and modulated by individual differences in self-reported anxiety (STAI), both results which are commonly observed for the ERN. In concordance with the hypothesis that the MCC integrates negative affect, pain and cognitive control demands (Shackman et al, 2011), the CS appears to index punishment-guided cognitive control.

F28

LOW AND HIGH SPATIAL FREQUENCY INFORMATION DIFFERENTIALLY DRIVES FEAR AND DISGUST PROCESSING Yuqi You[1], Wen Li[1]; [1]University of Wisconsin-Madison — Previous research from our lab shows divergent sensory encoding of individual threat emotions (e.g. fear versus disgust),

followed by functional convergence of these emotions at later stages. However, the specific neural substrates supporting these operations remain unclear. We hypothesized that early emotion encoding in the visual system is primarily driven by low spatial frequency information through a rapid feedforward sweep of sensory processing, whereas late-stage emotion analysis is dominated by high spatial frequency information via a slower cortical feedback route. In this study (N=27), we presented fearful, disgust, and neutral pictures in both low (<3 cycles/degree) and high (>7 cycles/degree) spatial frequencies followed (after 150 ms) by a simple visual search task. For high spatial frequency pictures, we replicated our earlier study (Krusemark & Li, 2011) using broadband pictures: search time was slowest after disgust, intermediate after neutral, and fastest after fearful pictures ($F(2,52)=176.49$, $p<.001$). In contrast, for low spatial frequency pictures, we observed a qualitatively different pattern. Search time was slowest after neutral, intermediate after fearful, and fastest after disgust pictures, leading to an overall significant emotion-by-spatial-frequency interaction ($F(2,52)=278.66$, $p<.001$). These behavioral evidence are in line with our hypothesis that beyond highly specialized processing of individual threat emotions, the low and high spatial frequency content of visual stimuli preferentially recruit distinct neural systems, contributing to diverse behavioral profiles. Further evidence is being collected with high-density measures of brain event-related potentials to elucidate the spatial and temporal properties of these operations.

F29

MAPPING THE MIND: A CONSTRUCTIONIST VIEW ON HOW MENTAL STATES EMERGE FROM THE BRAIN. Suzanne Oosterwijk[1], Kristen A. Lindquist[2], Eric Anderson[1], Rebecca Dautoff[3], Yoshiya Moriguchi[4], Lisa Feldman Barrett[1,3]; [1]Northeastern University, [2]Harvard University, [3]Martinos Center for Biomedical Imaging, [4]National Institute of Mental Health, National Center of Neurology and Psychiatry — Constructionist views on the mind propose that different mental states (e.g., emotions, thoughts, memories, perceptions) emerge from the same basic psychological operations. These psychological operations include core affect, conceptualization, language and executive attention. In the present study we used fMRI to examine how brain networks associated with these basic operations contribute to the experience of three different mental states. Participants were instructed to experience auditory scenarios describing negative events in three different ways; to focus on bodily sensations; to experience an emotion, or to think about the event in an objective way. A conjunction analysis demonstrated a common involvement across body focus, emotion and thought of core affective regions (e.g., anterior insular cortex, dorsal anterior cingulate cortex), regions associated with language (e.g., ventrolateral prefrontal cortex) and regions associated with working memory and cognitive control (e.g., dorsolateral prefrontal cortex). Contrast analyses demonstrated that body focus and emotion had stronger involvement than thought of several regions associated with affective salience and interoceptive representation (e.g., insular cortex). Areas within the default network (medial prefrontal cortex, temporal lobe, precuneus, pars triangularis) were stronger involved in emotion and thought compared to body focus, suggesting an important role for conceptualization when specifying mental content. Overall, the results show that different mental states involve similar brain regions, associated with basic processes such as conceptualization, language, executive attention and core affect, albeit with relative differences in strength of activation. These results enrich our understanding of how different mental states emerge from the brain.

F30

TEMPORAL DYNAMICS OF THE EARLY POSTERIOR NEGATIVITY IN EMOTIONAL VERBS. Marina Palazova[1], Werner Sommer[1], Annekathrin Schacht[1,2]; [1]Humboldt-Universität zu Berlin, [2]University of Göttingen — Emotional content impacts visual word processing. However, it is unclear, whether and how this depends on word class and at which functional locus this influence occurs. Results by Schacht & Sommer (2009) indicate that the early posterior negativity (EPN) component in event-related brain potentials (ERPs) to verbs arises later than the EPN to other word classes. In two experiments ERPs were recorded while subjects decided on the lexicality of positive, negative or neutral words. To examine the boundaries of the emotional ERP activation, word class and word frequency (Experiment 1), and word concreteness (Experiment 2) were manipulated. Results show that EPN onset does not depend on word frequency but on word class and word concreteness. In both experiments, an EPN only occurred after or at the same time as the lexicality effect, that is, when ERPs to words and pseudowords start to differ, indicating that EPN may represent emotion activation at a post-lexical processing stage.

F31

FUNCTIONAL MRI INVESTIGATION OF THE NEURAL CORRELATES OF OPPOSING EFFECTS OF EMOTION ON PERCEPTION AND MEMORY Andrea Shafer[1], Dan LaFreniere[1], Florin Dolcos[2]; [1]University of Alberta, [2]University of Illinois at Urbana-Champaign — An important question in the emotion literature concerns the link between immediate effects of emotion on perception/attention and longer-term effects on memory. Evidence from studies investigating the effect of task-irrelevant distraction presented concurrently with goal-directed tasks shows that manipulations of attentional demand (AD) of the main task influence the impact of emotional distraction (ED) on perception, However, it is unclear how these manipulations affect emotional memory (EM) for the distracting material. This issue was investigated using an orientation discrimination task with ED, followed by a recognition memory task for the distracters themselves. Functional MRI data were recorded while 18 participants discriminated between horizontal and vertical rectangular pictures with emotional and neutral content, in which AD was manipulated by the difficulty to discriminate between clearly rectangular and close-to-square rectangular shapes, and by stimulus duration (short/long). Behavioral analyses showed that while ED was greatest when processing resources were most available for distraction (AD of the main task was lowest), EM was highest when processing resources were least available (AD of the main task was highest). These results suggest dissociable mechanisms underlying immediate vs. delayed effects of emotion on perception and memory, respectively, and show that under conditions of limited resources available during encoding emotional information has privileged access to mechanisms leading to long-term memory. Preliminary analyses of fMRI data showed that activity in the medial prefrontal cortex and lateral parietal cortex dissociated the effects of ED and EM, respectively, whereas amygdala activity was common for both immediate and long-term effects of emotion.

F32

STRESS-MEDIATED ALTERATIONS OF CORTICAL ACTIVATION DURING A COGNITIVE FLEXIBILITY TASK John P. Hegarty, II[1], Bradley J. Ferguson[1], Nicholas H. Hopkins[1], Shawn E. Christ[1], David Q. Beversdorf[1]; [1]University of Missouri, Columbia — The brain mediates the physiological response following perception of psychological stress. Early studies suggest cognitive processing is susceptible to the effects of stress, and performance on tasks requiring a high degree of cognitive flexibility, specifically within the semantic network, is impaired by stress. We wish to determine the cortical mechanisms mediating behavioral changes in the presence of psychological stress. This was tested utilizing functional magnetic resonance imaging (fMRI), TR=2000ms TE=30ms ACPC-aligned slice number=32 at 4 mm3, during presentation of the Compound Remote Associations (CRA) task in the presence/absence of a psychological stressor, the Montreal Imaging Stress Task (MIST). Subjects attended two separate counterbalanced scan sessions (control and stress). Lists of three words that all form a compound word with a fourth word were presented and subjects were asked to generate the fourth word. CRA presentation was alternated with arithmetic problems with/without time constraints and with/without performance feedback, based on the Trier Social Stress Test, as part of the MIST stressor. Preliminary results based on repeated measures derived activation maps indicate higher activation

to task without the presence of a stressor in the inferior/dorsomedial frontal cortex, pre/post central gyri, thalamus, middle temporal/fusiform gyri, inferior parietal cortex, and lateral occipital cortex/occipital pole with the highest activation showing a rightward laterality. No regions showed higher activation for the stress condition. These findings reveal that stress may be altering cortical function through less network coherence between brain regions. Assessment of network coherence, functional connectivity, during stress is therefore warranted.

PERCEPTION & ACTION: Other

F33

INDIVIDUAL DIFFERENCES IN ACTIVATION OF TIME PERCEPTION NETWORKS PREDICTED BY GENOTYPE Martin Wiener[1], Yune-Sang Lee[1], Falk Lohoff[1], Coslett H.B.[1]; [1]University of Pennsylvania — Research into time perception and temporal processing networks have recently shifted attention from where timing occurs in the brain to how these regions are utilized. Crucially, new evidence suggests that time perception networks may be differentially engaged, depending on the temporal context. Recently, we reported that human subjects with genetic polymorphisms affecting distinct dopamine pathways are differentially impaired on time perception tasks at different duration ranges. This dissociation in performance suggests that individual differences in functional activation may be mediated by dopamine availability, as predicted by genotype. In order to address this hypothesis, we tested human subjects genotyped for a known polymorphism affecting nigrostriatal dopamine D2 receptors (DRD2/ANKK1-Taq1a: A1+ heterozygotes vs. A1- homozygotes) on a temporal discrimination task with event-related functional magnetic resonance imaging (fMRI). Timing networks were interrogated by contrasting activation during temporal discrimination with a color discrimination task. When examined as a unitary group, our results revealed activation in regions commonly associated with timing tasks (basal ganglia, prefrontal cortex). However, when performance was compared between genotypes, our results revealed that regional patterns of activation could be dissociated; A1+ allele carriers, with putatively normal levels of striatal D2, showed greater activation in the basal ganglia during temporal discrimination, whereas subjects with low levels of striatal D2 showed greater activation in right prefrontal cortex. These results suggest that A1+ allele carriers utilize a different network to accomplish temporal discrimination. Furthermore, our results provide support to the claim that time perception is mediated by multiple overlapping systems.

EMOTION & SOCIAL: Emotional responding

F34

INTRINSIC DYNAMICS OF EMOTION REGULATION NEURAL CIRCUITRY IN AGGRESSIVE AND OPPOSITIONAL YOUTH Christine L. Cox[1], Adriana Di Martino[1], F. Xavier Castellanos[1,2], Michael P. Milham[2,3], Clare Kelly[1]; [1]Phyllis Green and Randolph Cowen Institute for Pediatric Neuroscience at the New York University Child Study Center, NYU Langone Medical Center, [2]Nathan S. Klein Institute for Psychiatric Research, Orangeburg, NY, [3]Child Mind Institute, New York, NY — The amygdala and prefrontal cortex are consistently implicated in emotion regulation and are compromised in disorders characterized by emotional dysregulation. Youth with severe behavior disorders, e.g., Oppositional Defiant Disorder (ODD) and Conduct Disorder, often exhibit disproportionately heightened emotional responses to frustrating or threatening situations, which can lead to pathological levels of aggression. Here, we employed resting-state fMRI (R-fMRI) to examine differences in the intrinsic functional architecture of the brain associated with ODD. Specifically, we assessed the intrinsic functional connectivity (iFC) of social-emotional circuitry by quantifying correlated spontaneous low-frequency fluctuations in the R-fMRI BOLD signal. Youth with ADHD+ODD (ADHD+; n=40; 10.4±2.4yrs) were compared to youth with ADHD only (ADHD–; n=64; 10.2±2.6yrs). Typically developing youth (n=67; 11.1±2.5yrs) were included as an additional control group. We compared iFC associated with left and right amygdala among groups ($Z>2.3$, $p<0.05$, corrected), and examined the relationship between amygdala iFC and several measures of disruptive behavior ($p<0.05$). ADHD+ exhibited stronger negative iFC between the left amygdala and left ventromedial/orbitofrontal cortex, relative to ADHD– and controls. iFC between these regions was positively correlated with parent-reported oppositionality (ADHD+: $r=0.42$, $p<0.05$; ADHD-: $r=0.30$, $p<0.05$) and emotional lability (ADHD+: $r=0.38$, $p<0.05$; ADHD-: $r=0.24$, $p=0.056$) scores. Importantly, a relationship with aggressive behavior was observed only in ADHD+ (ADHD+: $r=0.35$, $p<0.05$; ADHD-: $r=0.15$, $p=0.24$). Intrinsic amygdala functional connectivity distinguishes aggressive, oppositional youth from those without ODD comorbidity, even within youth who share an ADHD diagnosis. Our results suggest that interventions targeting amygdala functions and circuitry may be particularly efficacious in this population.

F35

EXAGGERATED AUTONOMIC RESPONSES DURING EMOTIONAL PROCESSING AND VULNERABILITY TO ANXIETY IN PATIENTS WITH POSTURAL TACHYCARDIA SYNDROME Satoshi Umeda[1], Neil Harrison[2], Marcus Gray[3], Christopher Mathias[4], Hugo Critchley[2]; [1]Keio University, [2]University of Sussex, [3]Monash University, [4]University College London — Emotional processes are closely coupled to autonomic bodily responses. Neural centres for the control of autonomic bodily responses are implicated as substrates for normal and pathological emotions. This relationship may underlie constitutional vulnerabilities to affective disorders. Exaggerated patterns of autonomic responsivity can enhance the expression of panic or anxiety symptoms. Patients with postural tachycardia syndrome (PoTS) are characterized by abnormal autonomic responses. PoTS patients are overrepresented across stress-sensitive psychosomatic and neuropsychiatric disorders and experience symptoms that overlap with anxiety disorders. We combined emotional challenges with autonomic psychophysiology and functional brain imaging to test the prediction that PoTS patients show abnormal autonomic reactivity to emotional challenges through brain regions implicated in anxiety. Participants underwent fMRI with simultaneous heart rate recording while processing picture stimuli spanning five emotional categories. Physiologically, PoTS patients showed exaggerated heart rate responses to stimulus presentations, independent of emotional type. At the neural level, PoTS patients showed greater deactivation of ventromedial prefrontal cortex to stimuli and enhanced activity within precuneus, middle temporal gyrus and dorsal anterior cingulate cortex, compared to controls. The change in ventromedial prefrontal activity was related to the magnitude of heart rate change, while activity within globus pallidus and putamen correlated positively with state anxiety score. The degree of functional coupling between these frontal and striatal regions was further predicted by the magnitude of expressed anxiety. Our findings endorse the view that PoTS patients are constitutionally vulnerable to anxiety symptoms through the central generation and control of exaggerated autonomic reactions to external affective challenges.

F36

THE EMOTIONAL PICTURE PROCESSING OF OPTIMISTIC AND PESSIMISTIC PERSONS: AN ERP STUDY TsungHan Yang[1], NaiShing Yen[1,2], ChingHui Chueh[1], HuaFu He[1], Cong Chen[1], ShuAn Liao[1]; [1]National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan — Many studies indicated the characteristics of optimistic and pessimistic persons would influence their interpretation and emotional outcomes when they faced life events. Marchall (1992) and Chang (1996) found that optimism was positively related to positive emotion, and pessimism was positively related to negative emotions. However, whether the processing of central-nervous system of optimistic and pessimistic persons is different is unknown. The aim of our study is to examine the brain processes when

optimistic and pessimistic people view the emotional pictures. We adopted the Extended Life Orientation Test (Chang, Maydeu-Olivares, & D'Zurilla, 1997) as trait measures, dividing eight participants into optimistic and pessimistic categories. Then we used 132 emotional pictures from TAIWAN Affective Pictures System (TAPS), and measured their event-related potentials (ERP) when participants passively viewed these emotional pictures. These pictures were divided into positive (mean= 7.11), erotic (mean=4.84), general-neutral (mean=5.14), and negative (mean=3.11) categories. From the subjective arousal ratings, there were significant higher arousal scores for pessimistic than for optimistic persons in both positive and negative pictorial conditions. In subjective valence ratings, although there were not significant, the pessimistic participants would rate the positive pictures more positively and negative pictures more negatively than in optimistic ones. For ERP components, we analyzed the late positive potential (LPP) as an emotion -processing index. During 300-400ms and 400-800ms, the optimistic persons had larger LPP in Pz than in pessimistic ones, but pessimistic ones had larger responses in Fz and Cz. It seemed the optimistic and pessimistic persons have different emotional- processing nature.

F37

THE EFFECTS OF TINNITUS ON EMOTIONAL PROCESSING Jake Thompson[1], Fatima Husain[1]; [1]University of Illinois Urbana-Champaign — The aim of the study was to determine differences in the engagement of the emotional processing network in individuals with tinnitus relative to those without tinnitus. Our hypothesis was that tinnitus causes an impaired emotional response to affective auditory stimuli. Previous research has shown that an impaired limbic-auditory link influences the syndrome of tinnitus. Therefore, any disruption in the limbic system should be reflected in emotional processing. We conducted a functional MRI (fMRI) study using a 3T Siemens Magnetom Allegra MRI head-only scanner. Participants with or without tinnitus rated stimuli from the International Affective Digital Sounds (IADS) database as (a) pleasant (e.g., people laughing), (b) unpleasant (e.g., people fighting), or (c) neutral sounds (e.g., footsteps). Preliminary results showed that individuals with tinnitus responded more to the neutral sounds relative to the pleasant and unpleasant stimuli with extensive activations in the medial temporal gyrus, the inferior frontal gyrus, and medial temporal gyrus Preliminary results showed that non-tinnitus controls show greater response in limbic regions including the anterior cingulate, parahippocampal gyrus, cingulate gyrus for the pleasant and unpleasant stimuli relative to neutral sounds. Participants with tinnitus also exhibited greater frontal involvement for the pleasant and unpleasant stimuli compared to neutral stimuli. Increased frontal involvement suggests more top down control in individuals with tinnitus than in individuals without tinnitus. A larger study is being conducted to confirm the preliminary results.

F38

DEPRESSION AND ALEXITHYMIA DO NOT EXERT A CUMULATIVE EFFECT ON RECENT PAIN SEVERITY Maran Y. Hernandez Rodriguez[1], Janelle N. Beadle[2], Sergio Paradiso[2]; [1]University of Puerto Rico, [2]University of Iowa — INTRODUCTION. Depression and poor ability to perceive personal emotions and bodily sensations (alexithymia) are associated with pain. Depression and alexithymia are related but the extent to which their co-occurrence has additive effects on pain is not known. METHODS. Participants were 49 patients with depression (DSM-IV-TR, 2000) and 103 participants without current depression (i.e., 36 healthy volunteers and 67 with history of depression, in remission), average age was 52 years (SD= 17.9). Depression was assessed using the SCID (First et al., 2002); alexithymia using the 20-item Toronto Alexithymia Scale (Taylor,1992); pain severity over the last 24 hours using The Brief Pain Inventory (score range 1-10; McCaffery,1999). Participants were categorized into low (scores <61, N= 123) and high alexithymia (scores ?61, N= 29) groups. RESULTS. ANOVA with depression (present/absent) and alexithymia (high/low) as independent variables and pain as a dependent variable revealed a significant depression effect [$F(1,148)=1.6$, $p<0.01$], and depression by alexithymia interaction [$F(1,148)=4.6$, $p<0.05$]. Pain was most severe among patients with current depression without alexithymia (M= 2.91,SD= 2.76), and individuals with alexithymia without current depression (M= 2.76, SD= 2.40). DISCUSSION. Pain associated with depression and alexithymia was mild to moderate. Alexithymia and depression did not result in additive effects on pain severity. In depression, pain is believed to result from effects of sad mood (i.e., state) altering perception of bodily sensations, whereas in alexithymia poor perception of bodily sensations is a trait feature. Further research including measurement of on-line pain experience should investigate interactions between state and trait emotion processing alterations.

F39

LOOKING FOR THE SILVER LINING: AN FMRI STUDY ON REWARD RESPONSIVENESS AND PERSONALITY TRAITS Sarah Henderson[1], Catherine J. Norris[1]; [1]Dartmouth College — Why are some individuals so motivated by rewards whereas others are relatively immune? Although we know a great deal about how the brain processes rewards, far less is understood about how personality factors influence reward responsiveness. Using functional magnetic resonance imaging, participants completed a monetary gambling task and then viewed pleasant and unpleasant pictures. Participants also completed surveys to assess personality traits. We conducted a whole-brain t-test to determine areas more responsive to monetary rewards versus pleasant pictures, and then extracted beta weights to correlate with personality traits. Consistent with previous research using gambling tasks, several regions were more responsive to monetary wins, including bilateral caudate, DMPFC (BA 10), and posterior insula. In each of these regions, higher scores on positive personality traits (e.g., agreeableness, openness, subjective well-being, optimism, positive activation) and lower scores on negative personality traits (e.g., anxiety, loneliness) correlated with less neural activation to rewarding gambling outcomes. We also found regions that were more responsive to pleasant pictures than monetary rewards, including bilateral visual cortex and the right DLPFC (BA 9). Again, higher scores on positive traits (e.g., optimism, PA) and lower scores on negative traits (e.g., loneliness, avoidance orientation) correlated with less neural activation to pleasant pictures. Overall, this pattern suggests that negatively-oriented individuals are more responsive to secondary rewards in regions that process emotion, reward, and attention. This greater responsiveness could suggest that negatively-oriented individuals are more reliant on external rewards to impact mood than individuals who are happier and more satisfied with their life.

F40

CORTICAL THINNING IN PSYCHOPATHY Martina Ly[1], Gregory Kirk[1], Joseph P. Newman[1], Kent A. Kiehl[2,3], Michael Koenigs[1]; [1]University of Wisconsin, Madison, [2]The MIND Research Network, [3]University of New Mexico — Psychopathy is a complex personality disorder characterized by interpersonal, affective and behavioral traits such as callousness, impulsivity, irresponsibility, glibness, lack of empathy and guilt, and poor behavioral control (Hare, 2003). In addition, this disorder is strongly associated with a high risk for substance abuse and criminal behavior. Lesion and imaging studies implicate frontal and temporal brain regions, specifically the ventromedial prefrontal cortex, superior temporal gyrus and paralimbic areas such as the amygdala, anterior cingulate cortex, and insula (Blair, 2008; Kiehl, 2006). However, the neuropathological basis of the disorder is not yet clear. We assessed psychopathy with the Psychopathy Checklist-Revised Version (PCL-R) in a sample of adult male prisoners (n=21 psychopathic inmates, n=31 non-psychopathic inmates) and utilized a surface-based whole brain analysis to detect cortical thickness differences. Relative to non-psychopaths, psychopaths exhibited significantly thinner cortex in a number of regions, including left insula and dorsal anterior cingulate cortex, bilateral precentral gyrus, bilateral anterior temporal cortex, and right inferior frontal gyrus. These neurostructural differences were not due to differences in age, IQ, or substance abuse. These results suggest that psychopathy is associated with a distinct pattern of cortical thinning, partic-

ularly in areas with important roles in emotional processing and social cognition.

F41

INDEPENDENCE AS A BUFFER FOR EMOTIONAL DISTRESS: THE EFFECTS OF SELF-CONSTRUAL STYLE ON MPFC AND AMYGDALA FUNCTION Lisa Hechtman[1], Ahmad Hariri[2], Tokiko Harada[3], Yoko Mano[1], Norihiro Sadato[4], Todd Parrish[1], Tetsuya Iidaka[3], Joan Chiao[1]; [1]Northwestern University, [2]Duke University, [3]Nagoya University, [4]National Institute for Physiological Sciences — Several researchers have found that Asian participants, relative to Westerners, report greater levels of emotional distress. Both independent self-construal style and self-enhancing bias in Westerners have been shown to uniquely contribute to this difference, while ethnicity per se does not. In line with a theory of independence as a protective factor against emotional distress, we have previously demonstrated that independent self-construal predicts decreased amygdala reactivity in response to negative emotional stimuli. In the present study, we attempt to identify additional psychological mechanisms by which individualism could serve as a buffer against emotional reactivity. Specifically, we primed 24 bicultural Asian Americans with individualistic or collectivistic values, and then had participants perform an emotional task during fMRI scanning. Whole brain regression analyses revealed that participants who focused on interdependence showed stronger dorsal MPFC activation in response to negative emotional stimuli relative to neutral geometric shapes (control). Given dorsal MPFC's involvement in appraisal and evaluation of emotional stimuli, we interpret this activity—along with decreased amygdala activity—as a shift away from an automatic focus on negative external stimuli towards a potentially less reactive emotional state.

F42

HEIGHTENED SKIN CONDUCTANCE RESPONSE TO ANIMATE, AROUSING VISUAL STIMULI RENDERED UNCONSCIOUS USING INTEROCULAR SUPPRESSION Nicholas Root[1], Laura Case[1], V.S. Ramachandran[1]; [1]University of California, San Diego — To what extent can we identify and react to emotionally arousing stimuli that we do not consciously perceive? Sympathetic nervous arousal as measured by galvanic skin response (GSR) is heightened to consciously perceived arousing images, but no study thus far has demonstrated physiological correlates of unconscious arousal in the neurotypical population. Visual suppression techniques can prevent a visual stimulus from reaching consciousness while leaving some unconscious visual processing intact, allowing researchers to present arousing images without the subject's awareness. Individuals with snake or spider phobias show a heightened galvanic skin response (GSR) to backward-masked images of the objects they fear. How specific is the GSR response to emotionally arousing images, and does it occur only in individuals with heightened emotional responses such as phobias? To address this question, we measured subjects' GSR during conscious and unconscious image presentations. Emotionally arousing and neutral images were presented in random order and depicted both animate and inanimate entities. The animacy dimension allowed us to distinguish between animals, which humans could have evolved to automatically and unconsciously detect, and man-made objects, to which a fear response could reflect only learning across the lifetime. We found a heightened GSR to suppressed images of arousing, animate objects, suggesting that sympathetic responses to manmade threats requires conscious awareness of the threat. We hope to confirm this result by testing subjects with phobias to manmade objects (e.g., needles). If our hypothesis is true, we would expect to see no heightened GSR to suppressed images of their phobia.

EXECUTIVE PROCESSES: Working memory

F43

EFFECT OF LEFT SUPRAMARGINAL GYRUS TMS ON WORKING MEMORY INTERACTS WITH VERBAL COGNITIVE STYLE David J.M. Kraemer[1], Roy H. Hamilton[1], Samuel B. Messing[1], Jennifer H. DeSantis[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania — Tasks are often solvable via numerous alternative strategies. One reliable individual difference is self-reported preference for using visual or verbal information to complete a task -- e.g., when recalling a previously seen picture, some tend to rely on visual memory, while others focus on retrieving a verbal label. These separable preferences, termed visual and verbal cognitive styles, correlate with reasoning in visual and verbal domains. Recent neuroimaging evidence (Kraemer et al., 2009 JNeuroscience) linked cognitive styles to separate task strategies associated with distinct brain regions. Putatively corresponding with the labeling strategy, left supramarginal gyrus (SMG) activity correlated with the verbal cognitive style, particularly during a visual task. Relating to the visual imagery strategy, right fusiform gyrus activity during a verbal task correlated with visual cognitive style. Here, we use transcranial magnetic stimulation (TMS) to target left SMG specifically to test the hypothesis that activity in this region supports the use of a verbal strategy associated with the verbal cognitive style. First, we used the prior functional MRI paradigm with a new group of participants to localize SMG activity on an individual basis. Next, these functional peaks were chosen as targets for TMS, which was applied during the visual and verbal conditions of the same similarity-judgment task. SMG stimulation caused a decline in performance during the condition requiring conversion from pictorial image to verbal label. The magnitude of this effect was predicted by individuals' level of verbal cognitive style, supporting the hypothesized role of left SMG in the verbal labeling strategy.

F44

THE INFLUENCE OF MEDIAL TEMPORAL LOBE DAMAGE ON CAPACITY AND PRECISION IN VISUAL WORKING MEMORY weiwei zhang[1,2], Andrew Yonelinas[1,2]; [1]Department of Psychology, University of California, Davis, [2]Center for Mind & Brain, University of California, Davis — Visual working memory (VWM) is generally thought to be preserved in patients with medial temporal lobes (MTL) damage, but recent studies have indicated that these patients can exhibit deficits in VWM under some conditions. However, the specific functional roles that the MTL play in VWM is not yet clear. In the present study we used a color recall task in which observers attempted to reproduce one of the colors they saw a second earlier using a continuous color wheel. We tested perception and VWM in amnesics (i.e., hypoxic, temporal lobectomy and posterior cerebral artery infarct patients) and controls. A quantitative model was applied to the distributions of color recall responses to extract two independent measures of VWM: capacity and precision. Our results indicated that the amnesics exhibited impairments in VWM that arose because of reductions in both capacity and resolution. Moreover, there was evidence that the nature of the deficits depended on the patient etiology. The VWM impairments were not caused by perceptual deficits because the MTL patients showed normal performance on perceptual control tasks. Taken together, the results have provided novel evidence for the relationship between MTL and different aspects of working memory.

F45

THE EFFECTS OF 10 HZ RTMS ON SUSTAINED VISUAL ATTENTION AND VISUAL SHORT-TERM MEMORY Stephen M. Emrich[1], Jeffrey S. Johnson[1], David W. Sutterer[1], Bradley R. Postle[1]; [1]University of Wisconsin - Madison — Recently, an increasing number of studies have revealed that low-frequency oscillations may play a critical role in the maintenance of information in visual short-term memory (VSTM). This relationship has been further established through the use of high-frequency repetitive transcranial magnetic stimulation (rTMS), as stimulating areas critical to VSTM

retention at frequencies associated with short-term maintenance (~10 Hz) produces changes in delay-period alpha-band activity that are correlated with changes in memory performance. It is possible, however, that this relationship could reflect changes in sustained attention, rather than changes in VSTM maintenance. In the present study, we examined the effects of 10 Hz rTMS on VSTM performance, as well as on a perceptually and procedurally similar attention task with no mnemonic component. In the memory task, participants had to maintain the colors and locations of four items over a 1,600 ms delay period. In the attention task, the colors remained present in the display, and participants had to monitor the items for small changes in brightness. On half of the trials of both tasks, a 1 second train of 10 Hz rTMS was applied to the inferior intraparietal sulcus (IPS), an area associated with both VWM maintenance and attentional selection. While the VWM task and attention task exhibited dramatically different patterns of activity (alpha-band power increased during the delay period of the VSTM task, but decreased during the attention task), across both tasks rTMS-related changes in performance were positively correlated with rTMS-related changes in alpha-band power, suggesting a common underlying mechanism.

F46

CORTICAL AND STRIATAL CONTRIBUTIONS TO WORKING MEMORY: EVIDENCE FOR DISSOCIATED ROLES DURING UPDATING AND INTERFERENCE CONTROL Alan Ceaser[1], Deanna Barch[1]; [1]Washington University in St. Louis — Computational models have proposed that the basal ganglia interact with the cortex to control the flow of information during working memory processing (e.g. Hazy et al., 2007). They suggest that the dorsal striatum is responsible for sending updating signals that release regions of the frontal and parietal cortex from recurrent maintenance processing and that during interference control tonic inhibition of cortical regions may help to protect stored information in the cortex. This suggests somewhat differing roles for cortical and subcortical activity during working memory updating and interference control. We designed a novel task to test this idea. During the task we temporally isolate task encoding of a memory set, updating of this memory set, maintenance when presented with distractors, and simple maintenance. We scanned 16 subjects using slow event related fMRI and compared time course activity between trial conditions and between regions demonstrating a significant effect of trial type. We found that for regions in the frontal and parietal cortex activity was significantly greater during updating when compared to interference control, and activity for interference control was significantly greater than simple maintenance during the post update cue delay. In the caudate, putamen, and thalamus, however, activity associated with updating was significantly greater than interference control activity and simple maintenance activity, but we found no differences between interference control activity and simple maintenance activity. Our results are discussed in the context of the relevance of corticostriatal interactions during working memory and the implications for clinical populations like schizophrenia.

F47

FRONTAL-PARIETAL NETWORK DIFFERENCES FOR ITEM AND CATEGORY WORKING MEMORY Javier Gomez-Lavin[1], Kurt Braunlich[2], Carol Seger[2]; [1]The College of Charleston, [2]Colorado State University — Via fMRI, we compared activity related to working memory for specific faces to activity related to working memory for the category labels of these faces. Before scanning, participants were trained, via trial and error, to categorize 16 faces into two class sections ("A" and "B"). In the scanner, each trial began with the presentation of one of three cues: "Remember the Specific Face", "Remember the Category" or "Watch Passively." A face was then presented for 1 TR, and was followed by a 9-second delay. On "Specific Face" cue trials, a second face was then presented and participants were asked to indicate whether it was a "match" or "mismatch" to the first. Similarly, on "Category" cue trials, a second face was presented, and participants were asked to indicate whether this second stimulus matched the category of the first. For both Category and Specific Face cue trials, we found activity in frontal areas, the intraparietal sulcus, and the body of the caudate. Although largely recruiting similar brain bases, we found greater activity in medial parietal areas and the thalamus during Category cue trials than during Specific Face cue trials. Conversely, we found greater activity in high-level visual cortical regions and the middle frontal gyrus during Specific Face cue trials than during the Category cue trials. We also found differences in the time course of the BOLD response in frontal and parietal regions of interest.

F48

FLEXIBLE CONTROL OF RELEVANT AND IRRELEVANT SPATIAL INFORMATION REPRESENTATIONS IN WORKING MEMORY Chui Luen Vera Hau[1], Hoi-Chung Leung[1]; [1]Stony Brook University, SUNY — Many parts of the prefrontal and posterior parietal cortexes show sustained activity during short-term maintenance of visual and visuospatial information and their activity increases with increasing mnemonic demands. To this date, it remains unclear what kind of task information is represented in the sustained activity. In two experiments, we investigated the neural processing of visuospatial working memory using event-related potentials (ERPs) under different task conditions. We used a delayed recognition task with a cue presented during the delay period indicating only a subset of the initially memorized spatial locations remained relevant for the later recognition test, whereas the other subset was deemed no longer relevant. In the first experiment, we focused on examining the neural representations of post-cue transient activity by manipulating the selection or no selection of specific items in working memory. In the second experiment, we focused on examining the neural representations of post-cue sustained activity by manipulating the number of relevant and no-longer-relevant items. Our ERP data revealed that the post-cue transient activity (between 380-500 ms and 500-700 ms) differentiated between the different cue conditions whereas the post-cue sustained activity (between 900-2500 ms) was mainly modulated by the number of relevant items. Neural activity during the response phase was also modulated by the cue conditions, reflecting a more efficient memory search among the updated, smaller set of memorized items. In sum, our observations suggest that the neural representations during the delay period reflect both task context and memory content.

F49

GROUPING BENEFITS IN VISUAL WORKING MEMORY ARE DISRUPTED BY TDCS TO PARIETAL CORTEX Dwight Peterson[1], Marian Berryhill[1]; [1]University of Nevada, Reno — The Gestalt principle of perceptual grouping via physical connectedness improves visual working memory (VWM) accuracy. This performance benefit is thought to rely on neurons in the superior intraparietal sulcus (IPS) (Xu & Chun, 2009). In Experiment 1, we sought to replicate the behavioral effect (Xu & Chun, 2007, 2009). Only participants with high VWM capacity showed the grouping benefit. Participants with low VWM capacity showed no grouping benefit. In Experiment 2, we tested the importance of IPS involvement. We tested VWM performance in an independent sample of high VWM capacity participants with and without cathodal (suppressive) transcranial direct current stimulation (tDCS) to the IPS. Prior to VWM task performance, participants received cathodal tDCS to electrode site P4 (corresponding to the right superior parietal lobe) and sham tDCS during separate experimental sessions. As predicted by the behavioral results, normal IPS function was necessary for grouping effects to benefit VWM. The results showed a VWM grouping benefit in the sham condition, but this effect was suppressed after cathodal tDCS to the IPS. In summary, the results from Experiment 1 show that individual differences in VWM capacity interacts with the ability to take advantage of Gestalt grouping in VWM. Experiment 2 used tDCS to confirm the involvement of the IPS in mediating Gestalt grouping benefits in VWM.

F50

BRAIN ACTIVITY RELATED TO HIERARCHICAL REPRESENTATION OF TEMPORAL ORDER INFORMATION IN WORKING MEMORY Brooke Roberts[1], Charan Ranganath[1]; [1]University of California, Davis — Maintaining items in an appropriate sequence during working memory is important

for many daily activities; however, remarkably little is known about the neural basis of temporal working memory. The prefrontal cortex (PFC) plays a critical role in cognitive function, and may be functionally organized in a hierarchical manner, characterized by a rostro-caudal gradient. The purpose of this study was to test if temporal information is encoded and maintained in the same regions as item-specific information, and if there is a hierarchical representation of temporal information in the PFC. Participants were scanned during 3 task conditions (Item, Group, and Position), each requiring active maintenance of four images. Trials began with an instruction slide indicating condition, followed by two groups of two kaleidoscope images presented sequentially. Following a delay period, a probe was presented. On Item trials, subjects indicated if the probe was studied in that trial. For Group trials, subjects indicated if the probe was presented in group 1 or 2. For Position trials, subjects indicated whether the probe was presented first or second within its group. Relative to Item, Group and Position trials placed heavier demands on temporal order maintenance. Initial analyses indicate that lateral PFC and posterior parietal activation was enhanced during the delay period of temporal compared to item trials. Further analyses will focus on whether Position trials, which involve 2 levels of hierarchical temporal information, are characterized by enhanced activity in more rostral prefrontal regions compared to Group trials, which involve only 1 level in the hierarchy.

F52

NORMATIVE SHIFTS OF CORTICAL MECHANISMS OF ENCODING CONTRIBUTE TO ADULT AGE DIFFERENCES IN VISUAL-SPATIAL WORKING MEMORY Viola Störmer[1], Shu-Chen Li[1], Hauke R. Heekeren[1,2], Ulman Lindenberger[1]; [1]Max Planck Institute for Human Development, Berlin, Germany, [2]Department of Psychology and Education, Freie Universität Berlin, Berlin, Germany — Most previous studies investigating the cortical mechanisms underlying adult age differences in working memory (WM) capacity have focused on the maintenance phase. However, recent age-comparative evidence suggests that older adults' WM deficits may partly arise from impairments during encoding. Thus far, adult age differences in the relations between encoding and visual-spatial WM performance have not been assessed. To fill this gap, we used electroencephalography to track neural activity in the distinct phases of encoding and maintenance while younger and older adults performed a visual-spatial WM task. Relative to younger adults, older adults showed lower WM capacity and also less neural modulation during the retention interval (CDA component), consistent with previous findings. Moreover, we found age effects during encoding: Younger adults showed selective focusing of attention onto target items (N2pc component), whereas older adults mostly lacked this attentional focus, but showed modulations of initial stimulus processing (N1 component). The magnitude of the modulation of initial stimulus processing (N1) predicted WM capacity in older but not in younger adults, and the magnitude of the attentional focus (N2pc) predicted WM capacity in younger adults. These results suggest that there is a normative shift in the mechanisms used during WM encoding that contributes to adult age differences of visual-spatial WM.

F53

RESTING-STATE FUNCTIONAL CONNECTIVITY IN PRODROMAL HUNTINGTON'S DISEASE Stephen Rao[1], Katherine Koenig[1], Mark Lowe[1], Jian Lin[1], Deborah Harrington[2], Dawei Liu[3], Ken Sakaie[1], Jane Paulsen[3]; [1]Cleveland Clinic, [2]UCSD, [3]University of Iowa — Individuals in the prodromal phase of Huntington disease (prHD) show abnormal brain activation patterns on task-activated fMRI in the absence of changes on neuropsychological testing and structural brain imaging. Functional connectivity MRI (fcMRI), measured from low-frequency fluctuations in the blood oxygen level dependent (BOLD) timeseries during rest, has the potential to identify disruptions in intrinsic brain connectivity in early prodromal stages of HD. To date, no study has evaluated whether fcMRI is sensitive to disease progression and therefore, could serve as a biomarker for future HD therapeutic trials. The current study obtained task-activated and resting-state BOLD imaging in 16 gene-positive and 8 gene-negative participants. The gene positive group was subdivided into two groups: 8 close to diagnosis of manifest HD (CLOSE) and 8 far from diagnosis (FAR) based on age and CAG repeat size. Activation data from a time discrimination task (Rao et al., Nature Neuroscience, 2001) was used to identify seeds (left insula, right SMA) for the fcMRI analyses. Functional connectivity maps based on temporal correlations between regions were created for each individual. ANOVAs demonstrated that connectivity strength was highest in the gene-negative group, intermediate in the FAR group, and lowest in the CLOSE group. Progressively weaker connectivity as individuals approached diagnosis was found between the left insula and the anterior cingulate, posterior cingulate, and bilateral thalami and between the right SMA and the right insula and left putamen. This report is the first to demonstrate that resting-state fcMRI may be a sensitive biomarker of disease progression in prHD.

F54

INDIVIDUAL DIFFERENCES IN WORKING MEMORY CAPACITY MODULATE FRONTAL CORTICAL ACTIVITY WHILE LISTENING TO SPEECH IN NOISE Örjan Dahlström[1], Ingrid Johnsrude[1], Mary Rudner[1], Stefan Stenfelt[1], Jerker Rönnberg[1]; [1]Linnaeus Centre HEAD, Linköping University, Sweden — Many studies have demonstrated that the posterior part of the left inferior frontal gyrus (pLIFG; partes triangularis and opercularis) is recruited when speech becomes difficult to understand (Rodd et al, 2011). However, much is still unclear about how this region participates in speech comprehension. Here, we examine whether individual differences in working-memory (WM) capacity (as measured using the reading-span task: Daneman & Carpenter, 1980) modulate activity in this region when listeners are attempting to understand speech in noise. Twenty-seven participants heard sentences in noise at five different intelligibility levels (30, 50, 70, 80 and 90% correct), in the silent gaps between scans in a sparse imaging procedure (TR=10sec, TA=3sec). SNRs yielding target intelligibility levels were individually defined before scanning using an adaptive procedure and standardized sentences (Hagerman & Kinnefors, 1995). Clear speech, noise only and silence were also scanned. Both pLIFG and left posterior superior temporal sulcus regions were significantly more active ($p<.05$ whole-brain corrected for multiple comparisons (FWE)) when speech was hard to understand (degraded) compared to when it was clear or impossible to understand (noise only), consistent with other work. The pLIFG cluster (79 voxels; t=7.78; -44, 25, 19) was used as an ROI within which to examine whether the relationship between intelligibility and activity is modulated by WM capacity. Compared to the low-WM group (median split on reading-span data), the high-WM group showed a stronger linear relationship between intelligibility and activation (t=3.30, p=0.030, FWE-corrected). These results suggest that pLIFG subserves processes related to WM.

F55

HOW TO OVERCOME RARE AND TEMPORARY CHANGES IN FAMILIAR EVENTS BY REORIENTATION Anne B. Kühn[1], Ricarda I. Schubotz[1,2]; [1]Max Planck Institute for Neurological Research, [2]WWU Münster — Changes in familiar events call for fast updating of either expectation or the "internal model". The aim of the present functional MRI study was to investigate neural correlates of this updating process after breaches of expectancy. Subjects learned visually presented 24-digit stimulus sequences. During fMRI, these sequences were presented cyclically and isochronously. Omissions of different size (1 digit, 3, 6 or 12 digits) unexpectedly occurred without disturbance of the isochronous presentation. Subjects were required to indicate omissions by key press and to reorientate within the presented stimulus sequence at the same time. A parametric analysis of omission size permitted to disentangle activation of reorientation and that of omission detection. A parametric analysis of increasing distances between omissions further allowed exploration of the BOLD effect of initiating reorientation. We found the precuneus (Brodmann Area [BA] 7/31), posterior parietal areas along the intraparietal sulcus (BA 7), and the dorsal premotor cortex close to the superior frontal sul-

cus (BA 6/8) to be activated by the analysis of omission size. The size of omissions and the degree of activation correlated positively. Further, the analysis of the distances between omissions revealed higher activation levels of anterior ventrolateral prefrontal cortex (aVLPFC, BA 47) and pregenual anterior cingulate cortex (ACC, BA 32) the more rarely omissions occurred. Results demonstrate that a fronto-parietal network mediates the updating of the internal model of an event when expectation is violated. The aVLPFC and pregenual ACC seem to trigger this reorientation in case of situations that make strongly accustomed behavior inappropriate.

F56

CHARACTERIZING MEDIAL TEMPORAL LOBE CONTRIBUTIONS TO RELATIONAL MEMORY OVER SHORT DELAYS Liz Race[1], Margaret Keane[1,2], Mieke Verfaellie[1]; [1]Boston University School of Medicine & VA Boston Healthcare System, [2]Wellesley College — Short-term memory (STM) traditionally has been viewed as independent of the medial temporal lobes (MTL). However, recent studies have reported MTL activity, and disrupted performance with MTL damage, during STM tasks that require relational memory. While these results suggest that the MTL supports relational STM, an alternative interpretation is that MTL involvement in STM tasks reflects long-term memory (LTM) demands. Shrager et al. (2008) suggested that dependence on STM in short-delay recognition tasks can be operationalized with reference to effects of distraction in controls, on the assumption that STM, but not LTM, is sensitive to distraction. They showed that distraction had minimal effect on performance of a short-delay face memory task, but significantly reduced performance of an equivalent name memory task. Thus, it was argued that face memory depends on LTM, whereas name memory reflects the operation of STM. Importantly, amnesic patients were impaired on the former but not the latter task. Here we challenge the assumption of intact STM in amnesia by highlighting ambiguities in using distraction to operationalize the contribution of STM. We hypothesize that when performance on a short-delay face memory task relies on maintaining relational information, (a) control performance will be disrupted with distraction that specifically targets relational memory and (b) amnesic patients with MTL damage will be impaired at this task. Study results confirmed these hypotheses and indicated MTL involvement in relational STM. Further, intact performance in a patient with restricted hippocampal damage suggests that MTL cortex may be particularly critical for relational STM.

F57

WORKING MEMORY AND AMNESIA: THE ROLE OF STIMULUS NOVELTY Nathan Rose[1,2], Rosanna Olson[1,2], Fergus Craik[1,2], Shayna Rosenbaum[1,3]; [1]Rotman Research Institute at Baycrest, [2]University of Toronto, [3]York University — Despite the traditional view that damage to the hippocampus and/or surrounding areas of the medial temporal lobe (MTL) does not impair short-term or working memory (WM), recent research has shown MTL amnesics to be impaired on WM tasks that require maintaining a small amount of information over brief retention intervals (e.g., maintenance of a single face for one second). However, the types of tasks that have demonstrated WM impairments in amnesia tend to have involved novel stimuli. We hypothesized that WM may be impaired in amnesia for tasks that require maintaining novel information, but may be preserved for more familiar material, particularly if the material can be easily rehearsed. To test this hypothesis, patient HC, a 22-year-old developmental amnesic with relatively preserved semantic memory and 20 age and education matched controls performed a delayed match-to-sample task that required maintaining a single famous or non-famous face for 1-8 seconds, digit span and reading span tasks, and a modified Brown-Peterson task that required maintaining a single high- or low-frequency word or a non-word for 4-8 seconds. HC's performance was impaired for non-famous faces but preserved for famous faces, impaired for the reading span task but preserved for digit span, and it was impaired for non-words and unfamiliar low-frequency words but preserved for familiar words. These results support the hypothesis that an intact hippocampus is necessary for maintaining a single novel stimulus in WM. However, stimulus familiarity and rehearsal support WM via cortical regions independent of the MTL.

LANGUAGE: Other

F58

NEURAL CORRELATES OF MORPHOLOGICAL AWARENESS IN BILINGUAL CHINESE-ENGLISH CHILDREN: AN FMRI INVESTIGATION OF CROSS-LINGUISTIC READING ACQUISITION. Ka I Ip[1], Lucy Shih-Ju Hsu[1], Jie Chen[1], Maria M. Arredondo[1], Kira Mascho[1], Lydia Su[1], Twila Z. Tardif[1], Ioulia Kovelman[1]; [1]University of Michigan — Research in alphabetic languages (e.g., English) has consistently shown that Phonological Awareness, the ability to manipulate phonemic units of language, strongly predicts successful reading acquisition. In contrast, research with non-alphabetical languages (e.g., Chinese) suggests that Morphological Awareness, the ability to manipulate the morphological units of language, might better predict reading success and dyslexia (McBride-Chang et al., 2011). Despite these cross-linguistic differences, there are critical similarities between Morphological and Phonological Awareness as both are forms of metalinguistic awareness that require segmentation and manipulation of word parts. HYPOTHESIS. Similar neural mechanisms might underlie children's morphological and phonological awareness abilities in Chinese and English. METHOD. In this fMRI study, Chinese-English bilingual children (ages 7-12) performed auditory Morphological Awareness tasks in two languages. RESULTS. Participants showed overlapping activation between their two languages in left inferior, middle frontal and posterior temporal regions, regions also known to be important for Phonological Awareness processing. Moreover, participants' performance on Morphological Awareness tasks in Chinese and in English correlated with their reading proficiency in these languages. CONCLUSIONS. The findings suggest that common neural and learning mechanisms underlie reading acquisition across different orthographies. This key common learning component might consist of children's sensitivity to the suprasegmental aspects of the linguistic stream (e.g., syllables and morphemes, as supported by left IFG and STG), as well as their ability to manipulate those parts (as supported by left MFG)– a hypothesis we continue to examine. Our findings carry implications for better understanding of reading acquisition and dyslexia across different orthographies.

F59

BILINGUAL ENHANCEMENTS IN SOUND PROCESSING RELATE TO EXECUTIVE FUNCTION ADVANTAGES Jennifer Krizman[1], Viorica Marian[1], Anthony Shook[1], Nina Kraus[1]; [1]Northwestern University — The experience of being bilingual appears to result in enhancements in executive functions, such as inhibitory control. How these advantages in cognitive function shape the underlying neural processing of sensory stimuli is relatively unknown. To assess the relationship between executive function and neural processing, auditory brainstem responses, cortical evoked responses, and behavioral measures of auditory processing and executive function were obtained in 60 adolescents of varying second language proficiency, matched on IQ and socioeconomic status. Bilinguals, when listening to the syllable 'da' presented in six-talker background babble, demonstrated more robust encoding of the stimulus compared to monolinguals. At the neural level, encoding of the spectral amplitude of the fundamental frequency (F0), a feature known to underlie pitch perception and grouping of auditory objects, was more robust in bilinguals compared to monolinguals. Behaviorally, bilinguals showed enhanced temporal processing of non-linguistic sounds (in a backward masking task). Cognitive advantages were seen in bilinguals in both auditory and visual domains (sustained, focused attention), relative to monolinguals. Sustained attention ability and temporal processing performance correlated with neural encoding of F0, suggesting a relationship between enhanced executive function and the strength of stimulus representation. The present findings suggest an enhancement for bilinguals in the neural

processing of specific sound elements that relate to auditory perception and cognitive abilities. The data support the view that bilingual experience shapes how the auditory system processes behaviorally-relevant sounds.

F60

RELATIONSHIP BETWEEN RHYTHM PERCEPTION AND READING AND LANGUAGE ACQUISITION IN BILINGUAL CHILDREN. Neelima Wagley[1,2], Alyssa Mastic[2], Ka Ip[2], Lucy Hsu[2], Xiaohong Wang[2], Jie Chen[2], Zhenqi Guan[2], Kira Mascho[2], Sarah Spath[2], Stefanie Younce[2], Twila Tardif[2], Ioulia Kovelman[2]; [1]Michigan State University, [2]University of Michigan — Behavioral and neuroimaging evidence suggests children's sensitivity to slow rhythmic modulations might be a key index of their developing language and reading capabilities. It is proposed that this sensitivity might underlie children's ability to acquire and map sounds onto their language's orthographic symbols. Reading acquisition research shows that sensitivity to slow rhythmic modulations correlates with phonological awareness and reading proficiency (Goswami, 2010). Further research in language acquisition shows that infants' babbling consists of producing rhythmically alternating syllables at frequencies of about 1.5 Hz (Petitto, 2001). Neuroimaging evidence supports this sensitivity as seen by a greater activation in Wernicke's area to 1.5 Hz relative to other frequencies (Kovelman et al., 2010). We hypothesized that children with language and reading impairments should perform worse on rhythmic sensitivity tasks than typically developing children, regardless of bilingual status. Thirteen typically developing bilinguals and 8 language and reading impaired monolinguals were tested. Participants listened and tapped to beeps of three frequencies (0.5, 1.5, and 3.0 Hz), and completed phonological awareness and short-term memory tasks. Results showed bilingual children tapped with significantly greater accuracy at all frequencies compared to language and reading impaired children. In children with language and reading impairments, phonological ability significantly correlated with rhythmic sensitivity at 1.5 and 3.0 Hz. As corroborated by the results, sensitivity to slow rhythmic modulations may underlie successful language acquisition. Tasks of rhythmic sensitivity are non-linguistic and could therefore help identify children with language and reading impairments across orthographies, regardless of language proficiency or bilingual status.

F61

MULTIPLICATION ENGAGES PHONOLOGICAL NETWORKS IN BROCA'S AREA DIFFERENTLY FOR DEAF SIGNERS AND HEARING NON-SIGNERS Josefine Andin[1], Örjan Dahlström[1], Peter Fransson[2], Jerker Rönnberg[1], Mary Rudner[1]; [1]Linköping University, [2]Karolinska Institute — In hearing individuals, multiplication relies mainly on the phonological loop while subtraction relies on the visuo-spatial sketchpad (VSSP; Lee & Kang, 2002). Little is known about arithmetic neural networks in deaf signers (DS). Since DS often perform worse than hearing non-signers (NH) on arithmetic in general and multiplication in particular (Traxler, 2000), we hypothesized that there are strategic differences between how groups recruit the phonological loop in multiplication, but not in subtraction, leading to differential activation of phonological processing areas in left inferior frontal gyrus (Broca's area). We investigated this using a blocked fMRI-design in which nine DS and 17 HN matched on age, gender, education and non-verbal intelligence (Raven & Raven, 1998) were tested on tasks of multiplication, subtraction and phonology (rhyme). The contrasts rhyme versus multiplication and rhyme versus subtraction were examined across groups within the region of interest defined by a probability map of Broca's area (Amunts, 1999). We observed a significant interaction between task (multiplication and rhyme) and group ($F = 12.64$, $p = .034$, FWE-corrected), where the HN showed higher activation for rhyme than for multiplication ($T = 4.55$, $p = .001$, FWE-corrected) whereas there were no differences in activations between tasks for DS. For subtraction versus rhyme no interaction with group was found. These results suggest that there are differences between DS and HN in the phonology dependent neural networks in Broca's area used during multiplication, which may be part of the explanation for poorer performance in deaf individuals.

F62

EARLY VERBAL TRACES ACTIVATED DURING SIZE COMPARISON. Elena Salillas[1], Paulo Barraza[1], Manuel Carreiras[1,2]; [1]Basque Center on Cognition Brain and Language. San Sebastian, Spain, [2]IKERBASQUE. Basque foundation for Science. Bilbao, Spain — It is debated whether quantity representation contains verbal information. We used Basque-Spanish bilingualism as a window in the detection of brain signatures of numerical verbal forms, when language is not necessary for the task. Two groups of balanced bilinguals who learned first math concepts in Spanish or Basque (LLMS / LLMB) performed a comparison between two digits while EEG was recorded. Basque language retains the base-20 system for naming some numbers (56 verbal form in Basque is "berrogeita hamasei", implying number words for 40 (berrogeita), 10 (hama) and 6 (sei). Other numbers imply the decimal system as in Spanish (46 verbal form both for Basque and Spanish is "berrogeita sei", containing the number words for 40 (berrogeita/cuarenta) and 6 (sei/seis). Two types of digit pairs to be compared in size were presented (Common pairs: 46 – 40 and Basque pairs: 56-40). Analysis of EEG phase synchrony to the presentation of the second digit showed synchronization in the gamma and beta bands for the Basque pairs in the LLMB group and only synchronization in the beta band for the Common pairs. LLMS group showed synchronization in beta for both pairs of digits. Analysis of the regional distribution in each of these bands showed large scale synchronization over left frontoparietal electrodes pairs for the gamma band effect, while bilateral synchronization over posterior-parietal electrodes pairs appeared for the beta gamma effect. Gamma band effect suggests access to the base-20 system by the LLMB group while comparing numbers, a verbal trace originated in childhood.

F63

LANGUAGE COMPREHENSION INTERRUPTED: ERP AND FMRI REFLECTIONS OF REPRESENTATIONAL CONFLICTS AND WORD DEGRADATION Nan van de Meerendonk[1], Dorothee J. Chwilla[1], Shirley-Ann Rueschemeyer[2], Herman H.J. Kolk[1]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, [2]York University, UK — 'Representational conflicts' between an expected and observed linguistic element indicate the possibility of an error. According to the monitoring theory of language perception such conflicts signal the need for control adjustments: attention is biased towards the unexpected element, leading to reprocessing of the input. However, other cognitively demanding inputs can also interrupt comprehension and signal that control adjustments are needed. The present study investigated whether, next to representational conflicts, a lack of bottom-up information due to visual degradation also elicits a monitoring response. First, the ERP response to two conflict conditions (syntactic agreement and plausibility violations) and a degradation condition were compared. Previous studies consistently found that representational conflicts elicit a P600 effect. Hence, the question was whether this would generalize to degraded words embedded within sentences. The results indicated that degraded words elicited a central-posterior positivity between 300-800 msec. We propose that a general monitoring process which evaluates the demands for control underlies the positivities elicited by representational conflicts and visual degradation. Second, an fMRI experiment was conducted with a focus on the left inferior frontal gyrus (lIFG), which has been implicated in general conflict resolution. Participants saw the same conditions as in the ERP experiment, and subsequently performed a Stroop task. The results showed that both the conflict and degradation conditions increased activation in the lIFG region that was selected based on the Stroop task. We propose that the lIFG biases attention not only to resolve conflicts, but also to compensate for a lack of bottom-up information.

F64

A HIERARCHY OF INTERNAL FORWARD MODELS IN SPEECH PRODUCTION Kayoko Okada[1], William Matchin[1], Sara Alshara[1], Gregory Hickok[1]; [1]University of California, Irvine — Recent models of speech motor control argue that motor commands generate forward predictions of the auditory consequences of those commands. Here we explore the possibility that such predictions are generated in a hierarchy of internal forward models. Recent psycholinguistic work has provided evidence that higher-level lexical and lower-level phonemic speech errors occur in inner speech but dissociate in imagined vs. silently articulated speech. Lexical effects are found in both conditions but phonemic effects are only found during articulation, suggesting a hierarchical organization. If forward predictions are generated at each of these levels, we should find more activity in some portions of auditory cortex during silently articulated speech compared to imagined speech because predictions are being generated from multiple levels, even though neither condition involves any auditory input. This is precisely what we observed in an fMRI experiment in which subjects were visually presented with a sequence of words that they were asked to reproduce in sync with a visual metronome. On each trial, they were cued to either silently articulate the sequence or to imagine the sequence without overt movements. As expected, we found more activation in primary somatosensory-motor cortex as well as other motor areas during the overt articulation condition, but we also found increased activation in secondary auditory cortex in the dorsal superior temporal gyrus. We suggest that this reflects forward predictions from a hierarchy of internal models.

F65

TEMPORAL RESOLUTION OF SENSORY OSCILLATORY ACTIVITY IN CHILDREN WITH A LANGUAGE-LEARNING IMPAIRMENT IS IMPROVED BY COMPUTERIZED AUDIO-VISUAL TRAINING Sabine Heim[1], Jennifer Thomas Friedman[1], Andreas Keil[2], Naseem Choudhury[1], April A. Benasich[1]; [1]Rutgers, The State University of New Jersey, [2]University of Florida — Speech processing requires exquisite temporal resolution in the central nervous system, at high spectral accuracy. Children with language-learning impairment (LLI) have consistently shown difficulty with tasks requiring such precise, rapid processing. Remedies based on neural plasticity assume that the temporal precision of neural coding can be improved by intense training schedules, such as the computerized audio-visual training Fast ForWord-Language (Registered Trademark, FFW). Here, we examined the extent to which FFW training affects early oscillatory responses in auditory cortex, using combined source modelling and time-frequency analysis of the human electroencephalogram (EEG). Twenty-one (6-9 year-old) children diagnosed with LLI received FFW for an average of 32 days. Before and after training children completed behavioral and EEG assessment. Twelve children with typical language development were also tested twice, with no intervention given. In the EEG sessions, children listened passively or actively to pairs of brief tones presented with short (70-ms) interstimulus intervals. During the first visit, we found reduced amplitude and phase-locking of early (45-75 ms) oscillations in the gamma-band range (29-52 Hz), specifically in the LLI group, for the second stimulus of the tone pair. Amplitude reduction for the second tone was no longer evident at the second visit, although LLI children still exhibited attenuated phase-locking. Behaviorally, improvements on standardized measures of language were observed in the LLI group after completion of FFW. Our findings suggest that poor sensory integration in LLI is ameliorated after training, while the temporal organization of the oscillatory response is still altered.

F66

ON THE ROLE OF THE DORSAL AUDITORY STREAM: SYLLABLE ONSET COMPLEXITY IN SPEECH PRODUCTION. Isabelle Deschamps[1,2], Shari Baum[1,2], Vincent Gracco[1,2,3]; [1]School of Communication Sciences and Disorders, McGill University, Montreal, Canada, [2]Centre for Research on Brain, Language and Music, McGill University, Montreal, Canada, [3]Haskins Laboratories — Clusters of neural activation surrounding the left superior temporal plane and in the vicinity of the parietal-temporal junction have been reported both for speech production and speech perception. These findings have been interpreted as suggesting that this region is involved in the processing of sensorimotor information associated with articulatory representations. However, because these clusters of activation encompass more than one distinct anatomical region, the specific contribution of each of these regions during speech production remains unclear. The objective of this study was two-fold: to investigate the role of (1) stimulus presentation modality and (2) phonological complexity on anatomically distinct cortical regions located along the superior temporal plane during speech production. To this aim, we used both visual and auditory pseudowords that varied in phonological complexity. Subjects had to repeat the pseudowords as they were heard or seen. Data were acquired on a 3T Siemens Trio MR scanner. A clustered sparse volume temporal acquisition paradigm was used in order to eliminate movement artifacts. Preliminary whole-group analyses demonstrate an increase in activation for phonologically complex stimuli presented in the auditory (but not the visual) modality in left hemisphere regions including the planum temporale, superior temporal gyrus, parietal operculum, precentral gyrus and supramarginal gyrus (see figure 1). Our results demonstrate that specific regions located along the posterior superior temporal plane are sensitive to increases in phonological complexity when stimuli are presented in the auditory, but not the visual, modality, supporting a more fine-grained representation of sensorimotor processing along the posterior superior temporal plane.

F67

BILINGUALISM AND EXECUTIVE FUNCTIONS: ERP EVIDENCE FROM A STROOP TEST Karin Heidlmayr[1], Sylvain Moutier[1], Barbara Hemforth[1], Frédéric Isel[1]; [1]Paris Descartes University, France — Executive functions have been shown to gain a benefit in their efficacy from activity-dependent training. In the present study, we investigated whether the increased capacity of bilinguals to manage inhibition due to code switching has an effect on conflict detection and resolution. To approach this question, the classic Stroop test constitutes a critical test as two competing processes, i.e. a highly automatic linguistic process (reading) and a controlled process (colour naming), are simultaneously involved. Two event-related potential (ERP) experiments were designed. In Experiment 1, 12 highly proficient successive French-German bilingual adults and in Experiment 2, 14 monolingual adults, native speakers of French, were recruited. Participants performed a manual version of the Stroop test. Beside the habitual congruent, incongruent and neutral experimental conditions a highly conflictual negative priming condition was included. As usually found, behavioural data showed a reduced Stroop effect in bilinguals compared to monolinguals. ERP data revealed an increased negativity in the incongruent compared to the congruent condition in the time window 350-600 ms at centro-parietal electrodes (N400 effect). Moreover, the negative priming condition was associated with an N200 effect in the time window 150-300 ms at parietal electrodes for monolinguals. Taken together, the present data reinforce the idea that multiple language use improves efficacy in resolving cognitive conflict. This benefit of bilingualism seems to show especially in conditions involving high conflict. These findings lend support to psycholinguistic models of bilingual language processing postulating a higher-order level of control being exerted on linguistic as well as on non-linguistic domains.

LANGUAGE: Semantic

F68

THE DYNAMICS OF BRAIN ACTIVATION IN SEMANTIC INTEGRATION: A STUDY COMBINING ERP AND EVENT-RELATED OPTICAL SIGNALS Jian Huang[1], Suiping Wang[1], Shiwei Jia[2], Mingxiang Wu[3], Hsuan-Chih Chen[4]; [1]Department of Psychology, South China Normal University, Guangzhou, China, [2]Shandong Normal University, Jinan, China, [3]Department of Radiology,

Shenzhen People's Hospital, Shenzhen, China, [4]Chinese University of Hong Kong, Hong Kong S.A.R., China — The neural basis of integrative processes in sentence comprehension has attracted much attention in psycholinguistic research. Both left inferior frontal gyrus (LIFG) and left anterior temporal lobe (LATL) have typically been associated with such integrative processes. However, the specific functions of the two brain regions remain unclear, especially for LATL whose activation signals are not easily detected in fMRI scans. In the present study, we used the Event-Related Optical Signal (EROS) technique (Gratton et al., 1995) that has both high temporal (less than 100ms) and spatial resolution (5-10mm) to examine the dynamics of brain activation in these regions for semantic integration in sentence reading. Fifteen participants read 300 sentences word-by-word and made a semantic judgment at the end of each sentence. The EROS responses were recorded simultaneously with ERPs time-locked to the sentence-final target words of high or low expectation based on the prior sentential context. The ERP results replicated previous findings, showing N400 and P600 amplitudes modulated by the expectation levels of targets. The EROS results revealed activation in LIFG, left superior/middle temporal gyrus (LS/MTG), and left middle frontal gyrus (LMFG) in the N400 and P600 time windows. More importantly, the activations in LATL differentiated between the low and high expectation conditions in a relatively early time window (from 192 to 256 ms). These results suggest that two different brain pathways may be involved in semantic integration, one from LS/MTG to LIFG/LMFG for slower and long-lasting integration, and the other at LATL for automatic and more rapid integration.

F69

WAIT A SECOND: ELIMINATING THE "SEMANTIC ILLUSION" IN ROLE-REVERSED SENTENCES Wing-Yee Chow[1], Colin Phillips[1], Suiping Wang[2]; [1]University of Maryland College Park, [2]South China Normal University — A number of recent findings have shown that the ERP N400 effect, normally a sensitive measure of semantic processing, is unaffected by the blatant semantic anomalies in 'role-reversed' sentences, e.g., "The thief arrested the cop". These apparent "semantic illusions" have been taken as evidence for a processing architecture in which online semantic interpretation can proceed independently from syntactic information (Kim & Osterhout, 2005; Kolk et al., 2003; Kuperberg, 2007). We instead attribute these effects to time needed for the processor to use sentence meanings to generate expectations for upcoming words. This predicts that simply by increasing the time between a verb and its arguments should cause the N400 to reappear. We tested this using the subject-BA-object-verb construction in Mandarin Chinese. We compared effects of role-reversals when the verb immediately follows its arguments (Short Distance: [yesterday afternoon]-cop-BA-thief-arrest) vs. when they are further apart (Long Distance: cop-BA-thief-[yesterday afternoon]-arrest). We found that role-reversals elicit a significant P600 effect in both cases, but a significant N400 effect was observed only in the Long Distance conditions. This suggests that when the verb appears just 600ms after the nouns (Short Distance conditions) the processor has insufficient time to generate expectations for the verb, but that 1800ms (Long Distance Conditions) is sufficient. This within-experiment contrast challenges the independent semantic interpretation hypothesis, and instead supports the view that the processor reliably uses a verb's arguments to generate expectations for the verb, provided that sufficient time is available.

F70

THE EFFECT OF BILINGUALISM ON LEXICAL AMBIGUITY RESOLUTION IN YOUNG ADULTS: EVIDENCE FROM BEHAVIOR AND EVENT-RELATED POTENTIALS Shanna Kousaie[1], Christianne Laliberté[2], Jessica Kumar[2], Rocío López Zunini[1,2], Vanessa Taler[1,2]; [1]Élisabeth Bruyère Research Institute, [2]University of Ottawa — Research suggests that bilinguals outperform monolinguals on tasks of attentional control (i.e., Stroop, Simon, and flanker tasks). This advantage is hypothesized to originate from more efficient inhibitory control in bilinguals resulting from the constant management of two languages. Inhibitory control is also important for the resolution of ambiguous words (homonyms; e.g., "bank", meaning "financial institution" or "river's edge"). We examined whether bilingualism affects lexical ambiguity processing. Monolinguals (n=4) and bilinguals (n=5) read sentences biasing the reading of a terminal homonym towards the dominant or subordinate meaning while electrophysiological recording took place (e.g., She worked behind the counter at the BANK). They judged the relatedness of target words that were either related to the contextually appropriate or inappropriate meaning of the homonym, or unrelated items. Preliminary results indicate a trend in response time (RT) toward a Language Group x Trial Type interaction ($F(2,14)=4.26$, $p=.06$): in bilinguals, RT differed for all three trial types, with fastest responses to contextually appropriate targets and slowest to unrelated targets, while monolinguals showed no effect of target type. Electrophysiologically, a Language Group x Trial Type x Site interaction ($F(8,56)=3.79$, $p=.01$) showed that in all midline electrodes bilinguals demonstrated a difference in N400 amplitude for all target types; unrelated targets elicited the largest amplitude N400, and targets related to the homonym's dominant meaning the smallest. Monolinguals showed a larger amplitude N400 for unrelated targets relative to targets related to either meaning, which did not differ. These results indicate differences between monolinguals and bilinguals in lexical ambiguity processing.

F71

AEROBIC FITNESS AND SEMANTIC PROCESSING DURING SENTENCE READING IN 9-10 YEAR OLD CHILDREN. Mark Scudder[1], Lauren Raine[1], Artur Direito[2], Jeremy Boyd[1], Kara Federmeier[1], Charles Hillman[1]; [1]University of Illinois at Urbana-Champaign, [2]Vrije Universiteit Amsterdam, The Netherlands — Evidence suggests that aerobic fitness is beneficial to aspects of cognition involving attention and memory; however, language processing remains relatively unexplored. The N400 is an ERP component that reflects the brain's response to potentially meaningful stimuli, and can be elicited by words during reading. As such, the N400 is commonly used as an index of semantic processing that is particularly sensitive to violations in context. PURPOSE: To investigate the relation of aerobic fitness on semantic language processing (N400) in 9-10 year old children. METHODS: Higher- (> 70th percentile) and lower- (< 30th percentile) fitness groups were formed based on participant's respective VO2 max percentiles. Neuroelectric measures were recorded while participants read 160 sentences, with half of the sentences containing either a semantic or syntactic violation. Participants indicated if a sentence contained a violation via a button press. The N400 for target words was compared across the 3 sentence types. RESULTS: Behavioral results revealed a trend in which higher-fit participants were more accurate and took less time deciding if sentences contained violations. Neuroelectric findings replicated previous work demonstrating that N400 amplitude is larger for semantically anomalous words, and indicated that N400 amplitude was larger and peaked slightly earlier in the higher-fit group relative to the lower-fit group across all three sentence types. CONCLUSION: Findings from this study extend a large body of research suggesting that aerobic fitness is beneficial to cognition, and extend the area of research to semantic language processing, which may have implications for aspects of scholastic achievement.

F72

NEURAL CORRELATES OF METRIC AND SEMANTIC EXPECTANCY Kathrin Rothermich[1,2], Sonja A. Kotz[2]; [1]BRAMS, Université de Montréal, Canada, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — During speech perception listeners make use of different temporal and rhythmic cues while processing lexical information. In stress-timed languages speech rhythm is mainly constituted of alternating stressed and unstressed syllables (called 'meter'). This prominent pattern leads to perceptual regularity and allows anticipating upcoming stressed syllables in the speech stream. This anticipation, in turn, influences the integration of future words into sentence context (Rothermich et al., in press). The goal of the present functional magnetic resonance imaging (fMRI) study was to explore the neural correlates of metric and

semantic expectancies. More specifically, we examined the nature of the relationship of these two forms of expectancies in an auditory sentence context. Furthermore, we studied how attention to task influences semantic and metric processing and how it may lead to activation of dedicated brain networks. Our results in both tasks show that regular meter facilitates semantic as well as metric processing in fronto-temporal areas. In addition, the metric task accentuates activation of sensorimotor areas (such as basal ganglia, pre-SMA, thalamus, and insula) in speech perception. Also, anatomically distinct areas in the left IFG respond to semantic and metric expectancy, displaying a rostral-caudal gradient in the prefrontal cortex. Implications of our findings are discussed within a subcortico-cortical speech processing framework (Kotz & Schwartze, 2010).

F73

GENDER DIFFERENCES IN INTERHEMISPHERIC ERP SYNCHRONY FOR NON-LITERAL LANGUAGE ("JOKES") PROCESSING Paul Moes[1], Elissa Lier[1], William Medendorp[1]; [1]Calvin College — Coulson and colleagues (e.g., Coulson & Williams, 2004) have shown hemisphere asymmetries of Event Related Potentials (ERP) for joke-sentence endings that involve a semantic frame-shift. These studies point to right frontal dominance in processing verbal humor, but few studies have examined individual differences using this paradigm. In addition, no studies have examined the extent to which hemispheres synchronize activity when processing language. Given the greater bilateral representation of literal language processing in some females (Vikingstad et al., 2000) we hypothesized that females would show reduced left-right hemisphere asymmetry for the N400 component of the ERP wave in response to joke endings. In addition, we hypothesized that females would show greater left-right ERP synchrony for the 300-500 msec. latency segment of the ERP wave. Visual half-field presentations were used to display three types of single-word sentence endings: 1) "Joke" ending (unexpected meaning; low probability), 2) "non-joke" ending (expected meaning; low probability), or 3) "filler" ending (expected meaning; high probability). Primary measures were N400 amplitude, and individual-participant "lead-pair" (i.e., left-right pairs) cross-correlation coefficients (e.g., over the 300-500 msec. span). Gender differences in asymmetry were found, but mostly for literal-expected sentence endings. However, females showed significantly greater synchrony between left-right lead pairs across conditions. In addition, females showed greater left-right synchrony for RVF/LH trials with filler endings, but greater synchrony for LVF/RH trials with non-joke and joke endings; males showed the reverse pattern. Results point to gender differences in asymmetry and synchrony, but also suggest that asymmetry and synchrony represent independent measurement constructs.

F74

IN SEARCH OF MEANING: ELECTROPHYSIOLOGICAL EVIDENCE OF SEMANTIC PROCESSING IN THE CEREBRAL HEMISPHERES Padmapriya Kandhadai[1], Edward W. Wlotko[2], Laura Giffin[2], Kara D. Federmeier[2]; [1]University of British Columbia, [2]University of Illinois — In a set of event-related potential studies, we examined the neural bases of hemispheric differences in semantic representation and activation by varying the type of semantic relation, the strength of relation and the lateralization of semantic context. Participants saw strongly and weakly related prime-target pairs that were either associated (strong: stray-cat, weak: attend-show) or categorically related (strong: church-mosque, weak: temple-school), or unrelated to each other (sum-stage). In a visual half-field design, central primes were followed by lateralized targets in experiment 1 whereas primes and targets were both lateralized in experiment 2. Participants made delayed semantic judgments between primes and targets. Target N400 activation showed greater semantic priming with central primes than with lateral primes. Whereas both strongly and weakly related pairs were facilitated in both left and right hemispheres (LH and RH) with central primes, only strongly related pairs were facilitated in both hemispheres with lateral primes. There was a LH benefit for strong associates with central primes but no hemispheric differences emerged with lateral primes. Across both studies, contrary to existing theories, weak categorically related pairs were facilitated more in the LH than in the RH. Finally, the results also show that LH but not RH N400 facilitation for weakly related information was correlated with the participants' behavioral judgments. Thus both hemispheres are able to activate associative and categorically related information but the LH might be better able to utilize the context to activate weakly related information leading to better explicit meaning apprehension even with weak contextual support.

F75

NEURAL CORRELATES OF TREATMENT EFFECTS ON ABSTRACT AND CONCRETE WORDS IN APHASIA: A PILOT STUDY Chaleece Sandberg[1], Swathi Kiran[1]; [1]Boston University — Persons with aphasia who are trained to generate abstract words in a specific context improve not only on the trained abstract items, but also on untrained concrete items in the same context (Kiran, Sandberg, & Abbott, 2009). It is unknown what the underlying mechanisms for this type of generalization are and if dissociable neural correlates of abstract and concrete word processing (Binder, Desai, Graves, & Conant, 2009) is a factor. The current study examined the neural activation patterns of abstract and concrete word processing in three persons with aphasia (1 female) before and after a word retrieval treatment for abstract words within a specific context (e.g., hospital). During both (pre- and post-treatment) fMRI scans, participants completed two different tasks specifically designed to elicit abstract and concrete word processing. All three participants improved on the trained abstract items and two of the three participants also showed generalization to untrained concrete words in the same context. Additionally, all three participants showed increased activation from pre- to post-treatment for both abstract and concrete words in left hemisphere language areas such as inferior frontal gyrus and middle temporal gyrus. This is in the face of relatively large and varying lesions. Nevertheless, subtle individual differences emerge among participants, between tasks, and between abstract and concrete words. These tentative results suggest that in general, success in treatment (including generalization from abstract to concrete words) is related to increased left hemisphere activation for both abstract and concrete words from pre- to post-treatment.

F76

STRENGTH OF NEGATION AND LICENSING NEGATIVE POLARITY ITEMS: AN ERP STUDY Ming Xiang[1], Anastasia Giannakidou[1], Steve SanPietro[1], Julian Grove[1]; [1]University of Chicago — Negative polarity items (NPI) such as "ever" and "any" are known to be subject to particular semantic and pragmatic licensing conditions, but the exact nature of the licensing condition is still under debate. Using ERP recording, the current study compared 4 grammatical licensing conditions with one unlicensed condition (Item=150, Subj=33). Following a context sentence "War and Peace was such a long novel.", participants saw one of the five conditions: a/b/c. "No/Few/Only Russian literature students could ever finish it."; d."Russian literature students were glad they could ever finish it."; and e. "Russian literature students could ever finish it.". On the critical word, the unlicensed condition (e) showed a larger posterior P600 (between 400-600ms) compared to the licensor "no" (a) and "only" (c) (ps<.05), but not relative to the licensor "few" (b) and emotive factives such as "glad" (d)(ps>.1) At the sentence final word, however, (e) showed a larger extended positivity (400-1000ms) compared to all 4 grammatical conditions (ps<.05). In an offline rating study (subj=19, on a 1-5 scale), all 4 grammatical conditions received significant higher ratings than the ungrammatical (e) (ps<.01). We conclude that (i). the licensing is carried out in a two-stage process: an early stage of grammatical computations and a late stage of pragmatic assessment; (ii). the critical feature that is being computed in both stages is the negativity of the licensing environment rather than the logical downward entailment (DE) property, contrary to the long-held assumption (since Ladusaw 1979) that DE is a fundamental semantic property underlying NPI licensing.

F77

EFFECTS OF SEMANTIC CONTEXT ON THE SYNTACTIC AND SEMANTIC P600 Alexis Cook[1], Martin Paczynski[1], Gina Kuperberg[1,2]; [1]Tufts University, [2]Department of Psychiatry, Massachusetts General Hospital — The P600 event-related potential (ERP) is thought to reflect continued analysis in response to syntactically ill-formed propositions (e.g. "the ladies would curtseys…") and sometimes to semantically highly implausible/impossible propositions (e.g. "the trumpets would curtsey…"). We have hypothesized that it is enhanced when anomalous propositions conflict with alternative competing representations. We examined the role of context in generating such competing representations by examining ERPs to violated verbs in two experiments. In Experiment 1, the anomalies were presented without context while in Experiment 2, they were preceded by a semantically constraining context (e.g. "In front of the Queen of England…"). In both experiments, we observed robust P600 effects to both syntactic and semantic anomalies (relative to non-violated verbs, e.g. "the ladies would curtsey"). Both syntactic and semantic P600 effects, however, were significantly larger in Experiment 2 (with context) than Experiment 1 (no context). In addition, an N400 effect was evoked to both syntactic and semantic violations in Experiment 1 but not Experiment 2. We suggest that a constraining semantic context biases towards the generation of an alternative semantic representation, possibly through prediction, and that the enhanced P600 reflected the additional costs required to override this representation in order to arrive at the correct (anomalous) interpretation of the input. More generally, these findings provide further evidence for highly dynamic interactions between semantic and syntactic processing during sentence comprehension.

LONG-TERM MEMORY: Episodic

F78

THE FUNCTIONAL IMPORTANCE OF FMRI RESTING STATE CONNECTIVITY Cornelia McCormick[1,2], Maher Quraan[1], Melanie Cohn[1,3], Taufik Valiante[2,4], Mary Pat McAndrews[1,2,3]; [1]Krembil Neuroscience Center & Toronto Western Research Institute, [2]Institute of Medical Sciences, University of Toronto, [3]Department of Psychology, University of Toronto, [4]Department of Neurosurgery, University of Toronto — Emerging research supports the utility of resting-state connectivity (RSC) in distinguishing between healthy individuals and patients with neurological and/or psychiatric diseases. However, the functional importance of RSC remains unclear. Temporal lobe epilepsy (TLE) can be used to address this issue because it causes focal damage to the hippocampus (HC), a component of the default network, and functional impairment of episodic memory. Here, we examined resting-state fMRI of 19 controls and 38 patients with TLE (20 right, 18 left), using a seed in the posterior cingulate cortex (PCC) to identify patterns of connectivity with the medial temporal regions in each hemisphere. First, we found symmetrical PCC-HC connectivity in controls whereas patients with TLE showed reduced connectivity to the damaged HC and increased connectivity to the contralateral HC. Second, to examine the functional importance of RSC, we correlated material-specific memory measures with PCC-HC connectivity. In controls, verbal memory increased with PCC-LHC connectivity, whereas non-verbal memory increased with PCC-RHC connectivity. TLE patients, who showed material-specific memory impairments (verbal for LTLE, non-verbal for RTLE), nonetheless demonstrated a similar pattern: connectivity to the damaged HC correlated positively with relevant memory performance. Third, in a subgroup (8 LTLE, 10 RTLE), we correlated pre-surgical connectivity with post-surgical memory change. In both groups, stronger connectivity to the damaged (and subsequently removed) HC predicted greater decline in relevant memory performance. Interestingly, stronger connectivity to the contralateral HC predicted better memory outcomes. These findings reveal the potential power of RSC to assess functional integrity of cognitive systems.

F79

ASSESSING RECOLLECTION AND FAMILIARITY OF SIMILAR LURES IN A VISUAL PATTERN SEPARATION TASK Michael Yassa[1], Jennifer Kim[1]; [1]Johns Hopkins University — Whether the hippocampus is selectively involved in recollection or supports both recollection and familiarity is subject to much debate. Recent proposals have suggested that recollection may be dependent on hippocampal pattern separation, while familiarity may rely more on computing a global match. In order to investigate the potential relationship between recollection-mediated recognition memory and pattern separation, we crossed a commonly used design to test recollection and familiarity (the Remember/Know paradigm) with a visual object recognition task that uses similar lures. Subjects (n=49) classified pictures as "old", "similar", or "new" based on the objects seen during study. In addition, after each response, participants were asked to indicate if they Remember (R) or just Know (K) that they've seen the stimulus before. As expected, we found that R responses were higher than K for items labeled "similar". Surprisingly, however, we also found that R responses were higher on false alarms (similar items labeled "old"), suggesting that recollection is just as frequent for false memories that do not engage pattern separation. When we categorized lures according to their mnemonic similarity, we found that R responses increased as a function of dissimilarity for "similar" responses" and increased as a function of similarity for "old" responses. Together, these results suggest that recollection is dissociable from pattern separation, and that, at least to the extent that the R/K procedure is a valid test of recollection and familiarity, false alarms to critical lures are not simply driven by familiarity responses.

F80

INTACT CONSTRUCTION AND MAINTENANCE OF SPATIALLY COHERENT MENTAL IMAGES IN MEMORY-IMPAIRED PATIENTS WITH HIPPOCAMPAL LESIONS. Soyun Kim[1], Grégoire Borst[2], William Thompson[3], Ramona Hopkins[4,5], Stephen Kosslyn[6], Larry Squire[1,7]; [1]University of California, San Diego, [2]Université Paris Descartes - Sorbonne Paris Cité, France, [3]Harvard University, [4]Brigham Young University, Provo, Utah, [5]Intermountain Medical Center, Murray, Utah, [6]Stanford University, [7]Veterans Affairs Healthcare System, San Diego — We evaluated the proposal that the hippocampus is necessary for constructing a spatially coherent mental image. We implemented two spatial mental imagery tasks that required participants to construct, maintain, and operate on a spatial mental image. The first task involved mental paper folding, and the second task required participants to hold images of objects in mind while deciding whether an arrow was or was not pointing in the direction of an object's prior location. The arrowhead could be any of three distances from that location. In the mental folding task, response times typically increase with each additional fold; in the arrow task, response times typically increase with greater distance to scan from the arrow to the object. In both tasks, patients with circumscribed hippocampal lesions performed as well as controls. Moreover, the response times of patient and control groups increased with more folds or greater distances to scan, implying that participants were using mental imagery to perform each task. The results suggest that the hippocampus is not needed to construct, maintain, or operate on at least some kinds of spatial mental images.

F81

FAMILIARITY MEMORY IS MULTIPLY DETERMINED: EVIDENCE FROM ELECTROPHYSIOLOGICAL ANALYSES OF LETTER FLUENCY Heather D. Lucas[1], Ken A. Paller[1]; [1]Northwestern University — The neural mechanisms that underlie familiarity are frequently investigated, but a consensus understanding has been elusive. The extent to which familiarity shares sources with implicit memory phenomena is one current topic of debate. By some accounts, familiarity is tied specifically to conceptual implicit memory, given that familiarity and conceptual priming are influenced similarly by many manipulations and exhibit similar neural correlates. However, less attention has been paid to the fact that familiarity can also be driven by perceptual factors and thus might relate to perceptual

implicit memory in some circumstances. Here we examined neural correlates of familiarity during recognition testing using a procedure whereby fluency for words was enhanced at the letter level (Alan Parkin and colleagues, 2001). Studied and unstudied words were derived either from two separate letter pools or a single letter pool ("letter-segregated" and "unsegregated" conditions, respectively) in a within-subjects contrast. As predicted, recognition accuracy was higher in the letter-segregated relative to the unsegregated condition. ERP analyses revealed typical parietal old-new effects from 500-700 ms in both conditions. Additional parietal-occipital old-new effects from 300-500 ms were present in the letter-segregated condition only. These effects continued through 500-700 ms and remained topographically dissociable from those in the unsegregated condition. In conjunction with other evidence, these findings show that familiarity is a multiply determined phenomenon that can arise from a variety of neurocognitive sources. Conceptual versus perceptual contributions to familiarity vary across testing circumstances, and both must be accounted for in conceptualizations of recognition memory and its neural basis.

F82

THE SPATIOTEMPORAL DYNAMICS OF SOURCE RECOLLECTION Zara Bergstrom[1], Richard Henson[2], Jon Simons[1]; [1]University of Cambridge, [2]MRC Cognition and Brain Sciences Unit, Cambridge — fMRI research suggests that different frontal and parietal regions support strategic processes that are engaged at different stages of recollection, from pre-retrieval processing of a cue to post-retrieval maintenance or evaluation of retrieved information. Whereas some of these regions respond in a content-general way, other regions are sensitive to the type of information being recollected. However, because fMRI has low temporal resolution, it cannot distinguish component processes at the time-scale at which recollection occurs. We therefore combined fMRI with source localisation of EEG/MEG—which has excellent temporal resolution—in order to investigate the spatiotemporal neural dynamics of recollection. fMRI and EEG/MEG data was collected from the same participants while they retrieved two different types of source information. These source recollection conditions were contrasted and compared against a common semantic retrieval control condition. For content-general recollection, results from both modalities converged in showing the strongest activations in parietal cortex. According to the EEG/MEG time-course, this activation was reliable at a post-recollection stage. Content-specific source recollection increased fMRI and EEG/MEG activation in the left lateral PFC, and EEG/MEG again suggested that this region was recruited at a post-retrieval stage. The results show remarkable consistency between regions identified with fMRI and EEG/MEG, and the combination of methods provide novel evidence of how these regions interact over time to support source recollection. The results suggest that although left lateral PFC and posterior parietal cortex may have different functional roles during recollection, both regions are involved in post-retrieval processing.

F83

PROSPECTIVE MEMORY IN AGE GROUPS 18-29 AND 80+ WITH THE MEMORY FOR INTENTIONS TEST (MIST) Sarah Raskin[1], Navneet Kaur[1], Sarah Isaac[1], Dana Estefan[1], Ginger Mills[1], David Correll[1]; [1]Trinity College — The purpose of this study was to compare the prospective memory of healthy adults in different age groups. The Memory for Intentions Test (MIST) was administered, a laboratory measure of prospective memory. This test includes both event-cued and time-cued items as well as a 24-hour delay item. We hypothesized that older subjects would perform better than younger subjects on the delayed task but that the younger people would perform better on laboratory tasks. This hypothesis was based on the age paradox, the tendency of older people to perform better on real world tasks and younger people to perform better on laboratory tasks. The data demonstrated no significant difference between the performance of people who are 18-29 and the people who are 80+ years on the delayed prospective memory task, as the age paradox would predict. However, younger people scored better on the MIST overall and made fewer errors. This suggests that the age paradox may only apply in conditions where individuals are able to use compensatory strategies.

F84

STRONGER TOGETHER THAN APART: IMPROVING MEMORY THROUGH UNITIZATION. Jamie Murray[1], David I Donaldson[1]; [1]University of Stirling — Episodic memory retrieval can be enhanced by 'unitization' - the encoding of multiple separate items as a single holistic stimulus. Unitization can even alleviate recognition deficits experienced by individuals with selective memory impairments, resulting in increased familiarity during retrieval. Here we investigate the effectiveness of interactive imagery as a strategy for encouraging unitization. Studies of associative recognition memory have previously shown that interactive imagery (imagining the concepts together) encourages unitization of related word pairs (e.g., traffic-jam or fountain-pen). The present study asked whether interactive imagery also encourages unitization of novel associations formed between un-related word pairs (e.g. butterfly-glasses or wolf-butler), ruling out the contribution of pre-experimental unitization. During an associative recognition task participants encoded un-related word pairs, either by creating mental images of each word separately, or by imagining the words interacting together. Behavioural results revealed that intact word pairs were recognized faster and more accurately when encoded using interactive compared to item imagery. Event-Related Potentials (ERPs) recorded at test allowed the neural correlates of familiarity (the 300-500ms bilateral mid-frontal old/new effect) and recollection (the 500-800ms left parietal old/new effect) to be examined. ERP results demonstrated an increase in the magnitude of familiarity for word pairs remembered using interactive imagery but not item imagery. By contrast, recollection did not differ following item and interactive encoding. The present data provides further evidence that unitization selectively enhances familiarity and, moreover, suggests that interactive imagery is an effective technique for creating unitized representations even when to-be-remembered stimuli are novel un-related associations.

F85

EARLY DEVELOPMENT OF EPISODIC MEMORY IS NECESSARY FOR THEORY OF MIND ONLY UNDER SOME CONDITIONS: EVIDENCE FROM DEVELOPMENTAL AMNESIA Jennifer S. Rabin[1], Anna Braverman[1], Donald T. Stuss[2,3,4], R. Shayna Rosenbaum[1,2]; [1]York University, [2]Rotman Research Institute, [3]University of Toronto, [4]Ontario Brain Institute — Remembering one's own past experiences in episodic memory (EM) and inferring other people's current mental experiences by having a theory of mind (ToM) are closely related in terms of the brain regions that they recruit and their co-emergence in early development. Findings of intact ToM in individuals with adult-onset amnesia who have impaired EM have called into question the causal nature of this relationship; still unknown is whether the normal development of one is necessary for the normal development of the other. To examine this possibility, we conducted a comprehensive assessment of ToM integrity in a developmental amnesic person (H.C.) who never developed normal EM due to bilateral hippocampal damage sustained early in life but who nonetheless can form semantic memories. H.C. performed as control participants did on all standard tests of ToM, whether the mental state inference involved detecting a false belief, faux pas, or intent that was sarcastic, empathic, or deceptive in nature. Reliance on facial expression, intonation, or motion cues to infer others' minds was similarly inconsequential to her performance. One exception was impaired performance on a novel, naturalistic test that involved imagining others' thoughts and feelings in response to photographs of familiar and unfamiliar individuals experiencing everyday situations. The results suggest that in amnesia, performance on laboratory-based tests of ToM may be achieved via the patients' intact semantic memory. In contrast, ToM as it occurs in the real world may depend on the development of detailed episodic representations or the processes shared between EM and ToM.

F86

MEDIAL TEMPORAL SCLEROSIS MODULATES THE NEURAL SIGNATURE OF EPISODIC MEMORY IN PATIENTS WITH TEMPORAL LOBE EPILEPSY

Marie St-Laurent[1,2,3], Morris Moscovitch[1,3], Mary Pat McAndrews[1,2]; [1]University of Toronto, Canada, [2]Toronto Western Research Institute and Krembil Neuroscience Center, Canada, [3]Rotman Research Institute, Toronto, Canada — Mesial temporal sclerosis (MTS) is commonly observed in individuals who suffer from medial temporal lobe epilepsy (mTLE). MTS affects the integrity of hippocampal tissue, a structure known to play a role in long-term memory; however, the mechanisms through which MTS affects memory are not well understood. Our goal was to assess how the presence of MTS modulates the neural correlates of memory tasks known to engage the hippocampus at retrieval. We tested individuals with right-lateralized TLE on a functional magnetic resonance imaging (fMRI) task in which individuals retrieved episodic memories with (autobiographical events) and without (laboratory events) personal relevance. We used FreeSurfer, an automated brain segmentation software, to quantify hippocampal volume asymmetry, which is a marker of MTS. Then, we conducted a multivariate analysis (Partial Least Squares) that assessed global patterns of brain activation correlating with MTS within our memory tasks. Greater right MTS was associated with poor modulation of task-relevant activity in the right hemisphere. Specifically, we observed reduced activation in several regions typically engaged during episodic memory retrieval (including the hippocampus, posterior cingulate cortex and angular gyrus) and reduced de-activation in regions typically 'turned down' during retrieval relative to our baseline condition (including the lingual gyrus and middle frontal gyrus). Further, greater atrophy correlated positively with magnitude of activation in left-lateralized regions typically engaged in retrieval such as the angular and inferior frontal gyri. Our results provide brain-wide neural mechanisms through which focal damage to the medial temporal lobe can disrupt the recollection of memory episodes.

F87

QUALITATIVELY DISTINCT MEMORY PROCESSES DURING THE COURSE OF AN EPISODIC RETRIEVAL TASK

Lucy Sykes[1], Lisa Evans[1], Damian Cruse[1], Edward Wilding[1]; [1]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University — We investigated changes in neural activity over the course of a memory retrieval task, assuming that the demands placed on monitoring the contents of retrieval would increase as the numbers of stimuli to which memory judgments were required also increased. Participants first studied words in one of two colours. Studied and new words were then presented in a neutral colour. Event-related potentials (ERPs) were acquired while people made old/new and then study colour judgments to the test words. The differences between ERPs associated with correct judgments to new words (correct rejections) and correct colour judgments to old words were compared for the first and the second halves of the retrieval task. These ERP old/new effects differed qualitatively from approximately 1000ms post-stimulus, indicating that not entirely the same retrieval processes were operating in support of accurate memory judgments over the retrieval task. The absence of evidence for this change in another experiment where auditory rather than visual contexts were used at study suggests the outcome is not simply an effect of time on task. It is possible that the effects specific to the second half of the retrieval task index additional processes engaged as the demands placed on distinguishing between similar memory representations increase. Irrespective of the accuracy of this account, the findings indicate there are circumstances where making functional inferences about patterns of neural activity in brain imaging experiments based on data averaged over the entirety of retrieval tasks might lead to inaccurate functional characterisations.

PERCEPTION & ACTION: Audition

F88

NEURAL PLASTICITY OF AUDITORY-VOCAL INTEGRATION FOLLOWING SHORT-TERM PITCH TRAINING

Hanjun Liu[1], Zhaocong Chen[1], Francis Wong[2], Peng Liu[1], Dongfeng Huang[1]; [1]Department of Rehabilitation Medicine, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou, P. R. China, 510080, [2]Department of Communication Sciences and Disorders, Northwestern University, Evanston, U.S.A., 60208 — Speech perception and production are tightly coupled, and both skills activate many overlapping regions of the brain. Neural mechanisms underlying auditory-vocal integration, however, are poorly understood. By examining the cortical responses to pitch errors in auditory feedback during vocalization following short-term pitch training, the present study was to address how perceptual learning of vocal pitch cues can alter the neural processing of auditory-vocal integration. Within a five-day perceptual training, native Mandarin-speaking adults learned to identify English pseudosyllables superimposed with five lexical pitch patterns of Thai language. At the time course of before, immediately after, and one week after training, both the experimental and the control subjects participated in a vocalization experiment, where they heard their voice pitch in auditory feedback shifted briefly and randomly during a sustained vocalization, and we measured the cortical responses to these pitch perturbations. Following training, the experimental subjects' perception to lexical pitch patterns was significantly improved as reflected by increased accuracy in differentiating the five lexical tones after training. Their cortical responses to pitch perturbation in voice auditory feedback were significantly larger after the pitch training than before training, and this training-induced enhancement even existed a week after the training. These findings demonstrate a neural plasticity in the auditory-vocal integration following perceptual speech learning, suggesting that our brain can effectively adjust the mechanisms underlying voice motor control as it gets exposed to dynamic changes in speech perception.

F89

WORKING MEMORY RELATES TO NEURAL TIMING IN OLDER ADULTS

Travis White-Schwoch[1], Samira Anderson[1], Alexandra Parbery-Clark[1], Nina Kraus[1]; [1]Northwestern University — Successful speech perception relies on the accurate neural encoding of sound. Delays in neural timing can account for a wide array of auditory processing deficits. One population at risk for these deficits is older adults; aging results in decreased neural synchrony, increased neural recovery time, and a reduction in inhibitory neurotransmitters —all important factors for precise neural encoding. What's more, cognitive abilities such as attention, working memory, and overall executive function decline with age. Here, we investigated the relationship between cognitive ability—specifically, auditory working memory—and neural precision in older adults. Subjects comprised a group of older adults (? 60 years old) with normal hearing who were tested on cognitive measures of auditory working memory and neural measures of speech encoding. Working memory related to neural timing, such that individuals with higher working memory capacities had earlier neural response timing. As such, these results suggest that the age-related declines in memory may be associated with deficits in temporal resolution. These findings contribute to our understanding of the cognitive and neural implications of aging and have consequences for potential remediation strategies. This work is supported by a NRSA Institutional Training Grant (T32 DC009399-01A10) and the NIH (R01 DC01510).

F90

THE EFFECT OF EEG ALPHA PHASE ON AUDITORY EVENT-RELATED POTENTIALS

Adam J. Culbreth[1], Molly A. Erickson[1], William P. Hetrick[1]; [1]Indiana University-Bloomington — Optimal stimulus encoding is dependent upon the nervous system's state of preparation. For instance, it has been shown that perception of simple stimuli, such as tones and lights, is dependent upon the phase of prestimulus alpha in the EEG at the

moment of stimulus onset (Lindsley, 1952). Despite a large body of research, however, studies rarely consider the brain's prestimulus state when interpreting results, such as the meaning and modulation of event-related potential (ERP) waveforms. The present project determined the influence of alpha phase at stimulus onset on the amplitude of the P50, N100 and P200 ERPs produced by the first stimulus (S1) of a dual-click sensory gating paradigm. Specifically, it was hypothesized that the ERP amplitudes would be larger for stimuli that onset on a descending phase of the alpha waveform. Two clicks were presented binaurally (500 ms ISI), with a 7-11 inter-trial interval. Trials were divided according to whether S1 onset occurred on the ascending or descending portion of the alpha waveform. The results of this study supported the hypothesis; the amplitudes of all three indices (P50, N100, P200) were significantly larger when S1 onset occurred on a descending phase of alpha compared to the ascending phase of alpha. Such findings have important implications for interpretation of the relative contribution of S1 in the use of the dual-click paradigm.

F91

AUDITORY NON-SPEECH SKILLS PREDICT INDIVIDUAL DIFFERENCES IN ADAPTATION TO DEGRADED SPEECH Julia Erb[1], Molly Henry[1], Frank Eisner[2], Jonas Obleser[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Max Planck Institute for Psycholinguistics, Nijmegen, Netherlands — Noise-vocoded speech is a spectrally highly degraded signal but it preserves the temporal envelope of speech. Listeners vary considerably in their ability to adapt to this degraded speech signal. Here, we hypothesized that individual differences in adaptation to vocoded speech could be predicted by non-speech auditory, cognitive, and neuroanatomical factors. We tested eighteen normal-hearing participants in a short-term vocoded speech learning paradigm (listening to 100 4-band-vocoded sentences). Non-speech auditory skills were assessed using an amplitude modulation (AM) rate discrimination experiment, where modulation rates were centered on the speech-relevant rate of 4Hz. Working memory capacities were evaluated, and structural brain scans were examined for anatomical predictors of vocoded speech learning using voxel-based morphometry. Interestingly, listeners who learned faster to understand degraded speech showed smaller just noticeable difference thresholds in the AM rate discrimination task. Forward digit span also correlated positively with the ability to adapt to degraded speech. Anatomical brain scans revealed that faster learners had increased volume in the left thalamus (pulvinar). These results suggest that adaptation to vocoded speech benefits from individual AM rate discrimination skills as both listening situations require the use of envelope cues in the auditory signal. Remarkably, this ability to adjust to degraded speech is reflected anatomically in an increased volume in a part of the thalamus which is strongly connected to the auditory and prefrontal cortex. In summary, individual auditory skills that are not speech-specific and left thalamus gray matter volume predict best how fast a listener adapts to degraded speech.

F92

BEHAVIORALLY RELEVANT TRAINING-INDUCED PLASTIC CHANGES IN AUDITORY SPATIAL REPRESENTATIONS Ayse At[1], Lucas Spierer[1,4], Micah M. Murray[1,2,3,5], Stephanie Clarke[1]; [1]Neuropsychology and Neurorehabilitation Service, Clinical Neurosciences Department, CHUV, University of Lausanne, Lausanne, Switzerland, [2]Radiology Service, Vaudois University Hospital Center and University of Lausanne, CH-1011 Lausanne, Switzerland, [3]Electroencephalography Brain Mapping Core, Center for Biomedical Imaging, CH-1011 Lausanne, Switzerland, [4]Neurology Unit, Medicine Dept, University of Fribourg, Switzerland, [5]Department of Hearing and Speech Sciences, Vanderbilt University Medical Center, Nashville, Tennessee 37232 — Training-induced neuroplasticity often co-occurs with behavioral improvements. However, the direct behavioral relevance of any such neuroplasticity remains unresolved. We addressed whether plasticity in auditory spatial representations following 4 consecutive days of training differs for positions where performance improved or not. Sixteen participants were trained on an auditory spatial discrimination task indicating whether pairs of right-lateralized sounds were at the same or at different locations. Two lateralizations resulting in differing difficulty levels were trained, generating a 2x2 within-subject design with factors of lateralization (easy/difficult) and day of training (1/4). 160-channel electroencephalography was recorded during the training sessions on the 1st and 4th days. Discrimination sensitivity (as indexed by d') improved significantly for the easy, but not the difficult lateralization (significant interaction: $F(1,15)=4.66$; $p<0.05$). A time-wise topographic analysis of auditory evoked potentials (AEPs) revealed significant Day×Position interactions over the 275-295ms post-first-sound onset and 150-175ms post-second-sound onset intervals. These preliminary findings suggest that mechanisms of training-induced plastic changes differ as a function of the behavioral outcome of training perhaps through the differential involvement of neural circuitry involved in comparing spatial representations.

F93

JUDGING DIFFERENT TEMPORAL FEATURES OF SOUND DRIVES SEPARABLE NEURAL TIMING NETWORKS Molly J. Henry[1], Merav Ahissar[2], Jonas Obleser[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Hebrew University of Jerusalem, Israel — Sub-second timing is important for the perception and production of speech and music. However, there is little consensus on the locus of the brain's 'internal clock'. In particular, comparing across studies generally means comparing across both stimuli and tasks simultaneously, making conclusions in this regard difficult. Thus, the current auditory fMRI study carefully contrasted stimulus and task differences during sub-second timing judgments. To reveal stimulus effects, listeners judged the duration of sounds that were either amplitude-modulated (around 8 Hz) or unmodulated. To reveal task effects, listeners judged either the duration (around 500 ms) or amplitude modulation rate of identical amplitude modulated stimuli. Decisions about both duration and modulation rate required discrimination of variations on the order of 100 ms. All conditions were matched in terms of difficulty. Stimulus effects included amplitude-modulated sounds activating right supramarginal gyrus more than unmodulated sounds, but were generally weaker than task effects. The task effects speak against a unitary 'internal clock' network: Duration judgments more than modulation judgments activated a number of areas standardly implicated in timing tasks, including supramarginal gyrus, inferior frontal gyrus, and bilateral basal ganglia. Conversely, modulation judgments were associated with bilateral activations in somatosensory cortex, and bilateral anterior and posterior cingulate. The results suggest that separable brain networks are recruited to discriminate different temporal features of sound, and thus suggest distributed, feature-dependent timing mechanisms.

F94

PREDICTING SOUNDS: BRAIN RESPONSES TO OMISSIONS OF SELF-GENERATED SOUNDS Iria SanMiguel[1], Erich Schröger[1]; [1]Leipzig University — We have sufficient indication that prediction affects the processing of incoming sensory information. Effects of prediction can be observed, e.g., in an attenuation of sensory responses to self-generated sounds or in the elicitation of the mismatch negativity to deviant stimuli. However we still know very little about the form that the underlying prediction leading to these effects takes in the human brain or whether different effects of prediction might be achieved through a common neurophysiologic substrate that represents the specific prediction. We hypothesize that sensory predictions are coded by specific patterns of pre-activation present in the same neural populations that respond to the predicted stimulus. To test this hypothesis, we have combined self-generation and regularity extraction into one paradigm to induce a strong, specific prediction. By randomly omitting a predicted self-generated auditory stimulus, we have isolated electrophysiological activity associated to the specific prediction. Event-related potentials to omissions of self-generated sounds resembled responses to the actual sounds in timing and amplitude over temporal sites and localized to auditory cortex

by means of inverse source modelling. Further, we tested whether omission responses reflect the physical characteristics of the predicted stimulus contrasting omissions of self-generated sounds of extreme high vs. low frequencies. Omission responses to extreme sound frequencies differed in the relative location of their sources on auditory cortex; again mimicking responses to the actual presentation of the auditory stimuli. Alltogether, these results suggest that indeed predictions are coded by at least partly the same neural populations that respond to the predicted stimulus.

F95

SENSORY-COGNITIVE INTERACTIONS PREDICT SPEECH-IN-NOISE PERCEPTION: A STRUCTURAL EQUATION MODELING APPROACH Samira Anderson[1], Alexandra Parbery-Clark[1], Travis White-Schwoch[1], Nina Kraus[1]; [1]Northwestern University — Speech-in-noise perception is a complex task which relies on sensory, cognitive, and neural mechanisms. This sensory-cognitive interaction is especially important for older adults; age-related declines in sensory function and neural precision lead to greater reliance on cognitive resources for understanding speech. Here, we used structural equation modeling to investigate the interactions among sensory, cognitive, and neural processes engaged when listening to speech in noise. We obtained measures of hearing thresholds and cochlear outer hair cell function, speech-in-noise performance, subcortical speech encoding, and cognitive ability (speed of processing, memory, and attention) from a group of middle- to older-aged adults (ages 45 to 79). A three-factor model demonstrated that measures reflecting sensory, cognitive, and neural processing all predicted speech-in-noise performance. Neural measures of temporal precision are more closely related to hearing thresholds and speech-in-noise performance than are cognitive measures; nevertheless, cognitive ability plays a stronger role when listening to semantically and syntactically complex sentences. As such, our results highlight the neural mechanisms underlying the reciprocal relationship between sensory and cognitive processes that are engaged when listening in noise. This work is supported by a NRSA Institutional Training Grant (T32 DC009399-01A10) and the NIH (R01 DC01510).

F96

DEFINING AUDITORY EXPERTISE USING MUSICIANS Erica R. Knowles[1], Alan C. N. Wong[2], Valeriy Shafiro[3], Patrick C. M. Wong[1]; [1]Northwestern University, [2]The Chinese University of Hong Kong, [3]Rush University — Recognition of perceptual categories is affected by experience. In the visual domain, types and degrees of visual experience can lead to visual expertise, which is described through a hierarchical framework of object categorization. This framework consists of three levels: superordinate (e.g., animal), basic (e.g., bird), and subordinate (e.g., robin), with subordinate being the most specific level of categorization. Based on this framework, visual expertise is defined by the ability to categorize stimuli at the subordinate level as quickly as at the basic level (Tanaka & Taylor, 1991). This definition of expertise has been fruitful in characterizing types of visual expertise (Bukach, Gauthier, & Tarr, 2006). In the present study, we examined whether such a framework can be extended to the auditory domain by investigating auditory perception in musicians. Musicians are ideal candidates for initial studies defining auditory expertise due to their extensive experience with musical sound. Following visual research, musician and non-musician participants were asked to make categorical judgments at three levels: Level 1 (animal vs. musical instrument), Level 2 (string vs. brass), and Level 3 (violin vs. cello/horn vs. trumpet). Musicians were found to be significantly faster at categorizing stimuli at Level 2 than non-musicians. There was no difference in response time between the groups at either Level 1 or 3. These results suggest that perceptual expertise functions under a similar framework across multiple sensory domains. Future research will consider characterizing auditory expertise outside the area of music, and will consider perceptual expertise resulting from exposure to multi-sensory objects.

F97

A MEG STUDY OF MUSIC PROCESSING BY BIMUSICALS: ARE THE NEURAL ACTIVITY INVOLVING TONAL DISCRIMINATION DIFFERENT BETWEEN HIGH- AND LOW-PROFICIENT BIMUSICALS? Rie Matsunaga[1], Yukari Asano[1], Koichi Yokosawa[1], Jun-ichi Abe[1]; [1]Hokkaido University — Bimusicals appreciate music of two distinct cultures and rely on the established tonality of each culture to distinguish between the two music. Our recent magnetoencephalography (MEG) study with 'Western music and traditional Japanese music' bimusicals indicated that differences in the location of neural activation, rather than differences in either the temporal properties or the strength of this activation, contributed to bimusicals' tonal discrimination. However, in that study the bimusicals were less proficient in traditional Japanese music while they had excellent command of Western music. Thus, our recent findings could be ascribed to proficiency level. The present study used a similar paradigm to assess the effect of high and low proficiency of traditional Japanese music. We used a group of nine high proficient (HP) bimusicals who have had special training of Japanese music and a group of nine low proficient (LP) bimusicals who have not. Both groups were comparable in proficiency level of Western music. Early-right-anterior-negativity (ERAN) elicited by out-of-key tones in Japanese music was significantly earlier in HP than LP, but those in Western music was not different between HP and LP. The results indicate that peak latency of ERAN is modulated by proficiency level. Despite of such proficient effect, the difference in peak latency of ERAN between Western and Japanese music was not observed in not only LP but also HP. Thus, it is likely that the temporal properties of neural activity did not contribute to the tonal discrimination between Western and traditional Japanese music.

F98

ATTENUATION OF AUDITORY ERP RESPONSES RESULTS FROM ACCURATE ACTION-EFFECT PREDICTION. Gethin Hughes[1,2], Andrea Desantis[1,2], Florian Waszak[1,2]; [1]Université Paris Descartes, Sorbonne Paris Cité, [2]CNRS (Laboratoire Psychologie de la Perception, UMR 8158), Paris — The auditory N1 event-related potential has previously been observed to be attenuated to tones that are triggered by human actions. This attenuation is thought to be generated by motor prediction mechanisms and is considered to be important for agency attribution. The aim of the present study was to test the degree to which action-effect predictability and prediction accuracy influence N1 attenuation. Participants performed one of four actions (two with the left- and two with the right-hand) on each trial that was followed by one of two tones. Two of the actions resulted in predictable tones (probability of 1 for one tone and 0 for the other tone), while the other two actions resulted in unpredictable tones (probability of 0.5 for each tone). In addition, button presses with each hand were associated with an overall probability of 0.75 for one tone and 0.25 for the other tone. This meant that even tones that were unpredictable based on the specific button press were partially predictable based on the overall hand-prediction. We analyzed both the differences between predictable and unpredictable tones, and, within the unpredictable condition, trials that were congruent or incongruent with the hand-dependent prediction. We observed no significant differences in N1 amplitude between predictable and unpredictable tones. Congruent tones resulted in significantly attenuated N1 amplitude compared to incongruent tones. These novel findings suggest that accurate action-effect prediction drives sensory attenuation of auditory stimuli.

THINKING: Development & aging

F99

THE NEURAL DEVELOPMENT OF ARITHMETIC: TASK-DEPENDENT RECYCLING OF NUMERICAL AND VERBAL MECHANISMS Rachna Mutreja[1], Jérôme Prado[1], James R. Booth[1]; [1]Northwestern University — The neural recycling hypothesis posits that learning arithmetic relies on the progressive ''recycling'' of evolutionary older neural circuits dedicated to magnitude comparison in the intraparietal sulcus (IPS). It has been

suggested, however, that the degree to which IPS mechanisms are recycled depends upon the degree of similarity with the novel task. For example, IPS mechanisms are more likely to be used when learning arithmetic concepts that involve number comparison (e.g., single-digit subtraction) than arithmetic concepts relying on the retrieval of number facts from verbal memory (e.g., single-digit multiplication). To investigate this issue, we asked typically developing children from ages 8 to 14 to evaluate single-digit subtraction and multiplication problems while in an fMRI scanner. We found that a region of the right IPS that was localized by a magnitude comparison task was increasingly involved in evaluating subtraction problems with age. Such developmental change, however, was specific to subtraction problems. First, we observed a developmental decrease of activity in this IPS region during multiplication problem-solving. Second, with increasing age, multiplication problems were increasingly associated with a region of the left Middle Temporal Gyrus (MTG) that was localized by a verbal processing task. Consistent with the recycling hypothesis, these findings suggest that the neural systems underlying magnitude comparison are recycled during the acquisition of arithmetic concepts that involve number comparison (i.e., subtraction). However, acquiring arithmetic concepts that are typically taught by verbal memorization (i.e., multiplication) rather rely on the brain systems representing verbal semantic knowledge in the left temporal cortex.

F100

AGE AND GENDER DIFFERENCES IN THE FEEDBACK-RELATED NEGATIVITY (FRN) IN A SIMPLE GAMBLING TASK. Jill Grose-Fifer[1,2], Katherine Navarro[1,3], Lillian Pena[1], Alison Higgins[1], Brooke Chiusano[1], Danielle Mascarelli[1], Tina Zottoli[2,4]; [1]John Jay College of Criminal Justice, CUNY, [2]The Graduate Center, CUNY, [3]Queens College, CUNY, [4]Saint Joseph's College, NY — Risk taking is more pervasive in adolescent males than in other groups. To investigate whether this increased prevalence might be related to relative differences in feedback processing, we investigated the effects of age and gender on the feedback related negativity (FRN). The EEG was recorded from both adults (25-35 years old) and adolescents (13-17 years old) in a simple monetary gambling task. Participants selected one of two colored cards that appeared on a computer screen and then received feedback about their choice. Consistent with previous studies, the event-related potential elicited by feedback (FRN) was found be larger to losses than to wins, and was also larger in adolescents compared to adults. However, follow-up ANOVAs indicated that both adult and adolescent males showed a significant Magnitude (large, small) x Valence (win, loss) interaction, whereas females did not. Females showed a clear differentiation between wins and losses of either magnitude, whereas males processed a small win much like a loss. These data suggest that large rewards might be more reinforcing for males than for females and therefore, might help to explain why males are more likely to engage in risk taking in real-world contexts. Furthermore, boys showed relatively longer latency FRNs to large losses in comparison to girls. In another study, we have shown that FRN latency correlates with risk taking on a behavioral gambling task. Therefore, these data suggest that sensitivity to feedback processing, as evidenced by the FRN, may be a sensitive predictor of risk taking in adolescents.

F101

THE FUTURE IS NOW: DIFFERENCES BETWEEN ADOLESCENTS AND ADULTS IN THE NEURAL AND BEHAVIORAL MARKERS OF INTERTEMPORAL CHOICE EVALUATION Dustin Albert[1], Jason Chein[2], Ashley Smith[2], Kaitlyn Uckert[3], Laurence Steinberg[2]; [1]Duke University, [2]Temple University, [3]University of California at Los Angeles — Prior research suggests that adolescents are drawn to the temptations of immediate rewards to a greater degree than adults. Dual-process accounts of adolescent decision making posit that this bias derives from a developmentally normative imbalance in the neural dynamics underlying adolescent choice behavior, such that immature cognitive control circuitry lacks the processing efficiency and functional integration to effectively modulate subcortical circuitry exhibiting heightened sensitivity to the approach value of immediately available rewards. The present study utilized fMRI to examine differences between middle/late adolescents (N=20, ages 13-21) and adults (N=20, ages 25-34) in neural activity and choice behavior corresponding to the comparative evaluation of sooner-smaller and larger-later rewards in an intertemporal choice task. Behavioral results confirm that adolescents are more inclined than adults to sacrifice the added value of a larger future reward in order to receive a smaller reward immediately. Furthermore, relative to adults, adolescents evince stronger evaluation-related engagement of brain regions implicated in incentive processing (including bilateral caudate), consistent with a processing bias favoring the immediate reward properties of choice stimuli. In addition, adolescents show stronger deactivation of regions implicated in cognitive control (including anterior cingulate and dorsolateral prefrontal cortex) when evaluating rewards with relatively longer delays, consistent with a failure to carefully consider the value of future rewards. Together, results suggest that neurodevelopmental theories of adolescent decision making would be improved by more explicit modeling of age differences in the neural processes underlying evaluation of the temporal properties of rewards.

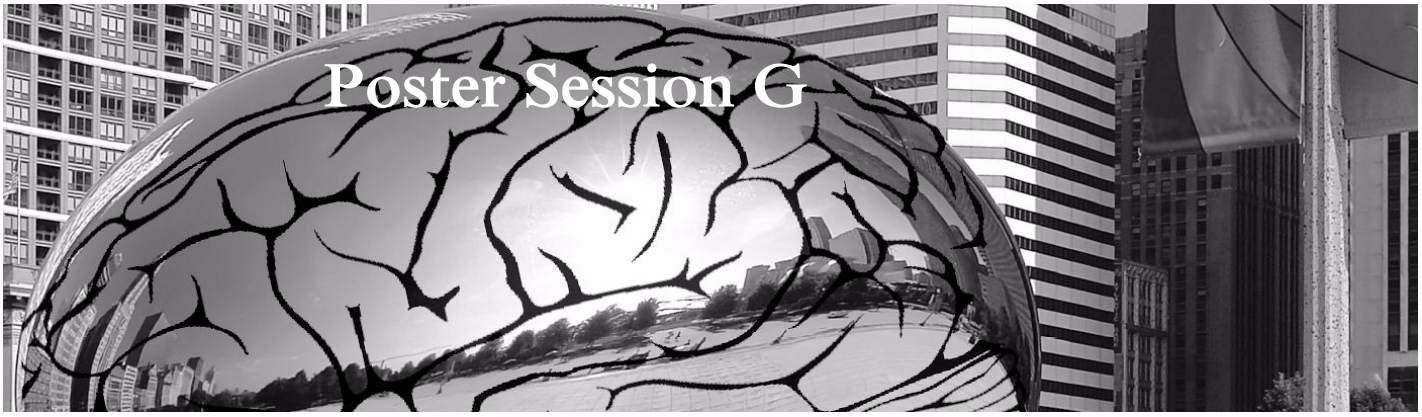
F102

UNDERSTANDING LESS THAN NOTHING: A DEVELOPMENTAL FMRI STUDY OF NEGATIVE NUMBER COMPARISONS Margaret Gullick[1], George Wolford[1]; [1]Dartmouth College — Little work has examined our understanding of counterintuitive quantities like negative numbers, which reverse the established relationship between digit magnitude and value, and how this processing develops. This study examined adults' and children's responses to negative and positive numbers in a simple paired comparison task performed during an fMRI session. Adults demonstrated a typical distance effect for negative numbers, with activity in the intraparietal sulcus (IPS) increasing as comparison distance decreased; further, adults generally showed more brain activity in the IPS and caudate for negative number comparisons than for positive. Fifth-grade children (who had not yet learned about negative numbers in school) were 83% accurate for negative numbers, but showed a reversed effect of distance in the IPS for negatives and more parietal and subcortical activity for positive than negative comparisons. Seventh-grade children (who had at least one year of instruction on negatives) demonstrated 86% accuracy and an adult-like IPS distance effect for negatives, but still showed more activity parietal lobe for positive than negative pairs. As such, adults demonstrated typical comparison effects for negative numbers in basic quantity-related brain areas, but also drew on supplementary areas including the caudate. Children's pre-instruction treatment of negative numbers was not adult-like; after a limited amount of instruction on and practice with negative numbers, children's neural comparison effects approached those of adults but were not completely mature. These changes in response patterns suggest a shift in negative number understanding, and perhaps flexibility in the mental number system.

F103

COMMON NEURAL MECHANISMS OF ARITHMETIC IN EDUCATED ADULTS AND PREVERBAL INFANTS Daniel Hyde[1], Kenneth Parreno[1], Elizabeth Spelke[1]; [1]Laboratory for Developmental Studies, Department of Psychology, Harvard University — Recent work suggests the possibility that mathematics is not completely culturally constructed, but rather, arises, in part, from an innately-specified, evolutionarily ancient brain system for number. To test this possibility we measured event-related brain potentials of infants and adults to animations devised to portray non-symbolic arithmetic problems. All subjects watched as two separate arrays of objects moved sequentially into a box, after which the box was removed to reveal a test array that was either more or less than the actual sum of the first two arrays. Adult subjects were asked to judge whether the test array was more or less than the actual sum. Reaction time decreased and accuracy increased as the ratio between the test array and the actual sum became larger. Evoked brain activity (P2p) to the test

array over parietal sites peaked around 250 milliseconds after stimulus onset and was also modulated by ratio between the number of items in the test array presented and the number of items there should have been the first two arrays were actually added together. Spontaneous mid-latency neural processing (infant P2p/P400) of the animations in infants also showed modulation of the parietal number system by the ratio between the total number of items that moved into the box and the actual number of items shown in the test array. These results suggest that infants spontaneously engage similar cortical networks to compute numerical expectations, as do adults actively performing arithmetic.



Monday, April 2, 5:00 - 7:00 pm, Exhibit Hall

ATTENTION: Spatial

G1

DIFFERENTIAL FRONTAL INVOLVEMENT IN SHIFTS OF INTERNAL AND PERCEPTUAL ATTENTION Ryan Tanoue[1], Marian Berryhill[1]; [1]University of Nevada, Reno — Perceptual attention enhances the processing of items currently being perceived, while internal attention enhances processing of items encoded in working memory (WM). In cueing paradigms, a cue indicates the to-be-probed item either before (pre cueing) or after (retro-cueing) the memory display and tests shifts of perceptual and internal attention, respectively. Both cue types confer similar benefits in accuracy (pre-: 14-19%, retro-: 11-17%) and neuroimaging data show that they activate highly overlapping frontoparietal networks (Lepsien & Nobre, 2006). Yet behavioral and neuroimaging differences have been reported suggesting that these two forms of attention can be disentangled. Here, we tested the hypothesis that internal attention relies more heavily on frontal activations than perceptual attention. We applied cathodal transcranial direct current stimulation (tDCS) to frontal (F4) and parietal (P4) cortices in separate experimental sessions. We predicted that suppressing frontal cortex would have a significantly greater negative impact on internal attention than on perceptual attention. Our results confirmed these predictions. Cathodal tDCS across site (frontal, parietal) and cueing paradigm (pre-, retro-) hindered performance. However, frontal tDCS had a greater negative impact on the retro-cued trials demonstrating greater influence on internal attention. These results concur with the neuroimaging data. We suggest that although internal and perceptual attention are mediated by the same frontoparietal networks, the weight of contribution of these structures differs, with internal attention relying more heavily on the frontal cortex.

G2

TOP-DOWN ATTENTION MODULATES THE CUING EFFECTS OF THE EMOTIONAL FACES Shwu-Lih Huang[1], Hung-Ta Chung[1], Yu-Chieh Chang[1]; [1]National Chengchi University — Fast detection of threatening stimuli and demanding more attentional resources to them were assumed to be helpful for the survival of the individuals. Relevant to this point, this study investigates the effect of threatening stimuli on attention and how this effect was modulated by the top-down attentional control using the cuing task. Participants were recruited from the normal population. Three kinds of schematic face (angry, happy and neutral face) were included as the cue. The percentage of valid trials (valid ratio: 75%, 50%, or 25%) was manipulated to observe the modulation effects of top-down control. Stimulus-onset-asynchrony (SOA) was also manipulated to observe the time course of the cuing effects. In Experiment 1, four conditions of SOA include 150, 300, 500, 1000ms. In Experiment 2, long SOA (500, 750, 1000 or 1250ms) was selected and the procedure of fixation cross darkened after cuing was introduced to enhance the IOR effect. From the results of two experiments, valid ratio was found to play an important role to affect the cuing effects. The higher the valid ratio is, the larger the validity effect obtained (Experiment 1). Also lower valid ratio enhanced the IOR effect (Experiment 2). For the effect of face emotion, only in 75% valid ratio condition of the Experiment 2, IOR effect was found to be different among three face conditions. Compared to the results of the studies using visual search or dot-probe tasks, we propose that competing between items is an important factor to reveal the effects of emotional stimuli.

G3

NUMERICAL REPRESENTATION DIFFERS SYSTEMATICALLY ACCORDING TO MENTAL ROTATION ABILITY Jacqueline Thompson[1], Hans-Christoph Nuerk[2], Korbinian Möller[2,3], Tudor Popescu[1], Roi Cohen Kadosh[1]; [1]University of Oxford, [2]Eberhard Karls University, Tübingen, Germany, [3]Knowledge Media Research Center, IWM-KMRC, Tübingen, Germany — Mental rotation ability and number skills have long been seen as bedfellows in the literature surrounding intelligence, but at what level of numerical cognition does this connection lie? With 34 participants representing a wide range of scores on the well-established Vandenberg & Kuse (1978) Mental Rotation Test, our study endeavoured to examine the possible link between mental rotation abilities and numerical representation. All participants completed a pen-and-paper mental rotation task, as well as a multi-digit number magnitude comparison task and a computer number-line estimation task. The numerical magnitude comparison task measured the compatibility effect (Nuerk et al., 2001), which indicates decomposed processing of tens and units digits, thus signalling the propensity to hold multiple number magnitude representations simultaneously; the number-line mapping task, on the other hand, is commonly interpreted as a measure of the precision of number magnitude representation, and additionally serves as a predictor for future mathematics skills in children (Booth & Siegler, 2008). We found that mental rotation ability correlated significantly with both size of the compatibility effect and with number mapping accuracy. Taken together, these correlations imply that mental rotation abilities are linked to numerical abilities at the level of number representation, in particular suggesting that higher mental rotation abilities may be associated with more precise and detailed number representation. These results also provide further evidence to the connection between spatial and numerical abilities, already well-supported by anatomical and behavioural evidence (Walsh 2003, Hubbard et al., 2005).

G4

BRAIN MECHANISMS OF SOCIAL COGNITION: THE KEY ROLE OF THE VENTROLATERAL ATTENTION NETWORK Jelena Ristic[1], Barry Giesbrecht[2]; [1]McGill University, [2]University of California Santa Barbara — Spatial orienting can be driven either by external events (reflexive attention) or by the current goals of an individual (voluntary attention). Two cortical networks subserve these processes-the ventrolateral network, which controls reflexive orienting, and the dorsolateral network, which controls volitional orienting. In the last decade, numerous studies reported that spatial attention is reflexively shifted in the direction of perceived gaze, but the relative contributions of the dorsal and ventral attention networks in social orienting remain unclear. We examined the neural dynamics of social orienting using electroencephalography (EEG) and Multiple Source Beamformer (MSBF) techniques. Participants viewed

central uninformative central gaze cues and detected peripheral targets. Analyses of the ERP data indicated that only individuals who showed social orienting effects exhibited increased target-evoked responses typically associated with spatial attention (e.g., P1) and larger N170 amplitudes. MSBF analyses indicated that the dissociation in behavioral performance between individuals who showed the social orienting effect and those that did not was accompanied by a dissociation between the two attentional networks. The regions comprising the ventrolateral network were activated in participants who displayed social orienting while the regions comprising the dorsolateral network were activated in participants who did not display social orienting. These findings strongly suggest that the ventrolateral attention network plays a key role in directing and maintaining social attention.

G5

SHIFTS FROM ENDOGENOUS TO EXOGENOUS ATTENTION ARE ASSOCIATED WITH MODULATION OF THE P300 COMPONENT Anne Berry[1], Jose Torres[1], Ursula Seals[1], Melisa Carrasco[1], Martin Sarter[1], William Gehring[1], Cindy Lustig[1]; [1]University of Michigan, Ann Arbor — Flexible behavior requires shifts between internally driven (endogenous) processing, and stimulus driven (exogenous) processing. Using a signal-detection task (the Sustained Attention Task, SAT), we have identified neural signatures of these shifts: frontal cholinergic transients in rodents, and transient BOLD activations of right rostral prefrontal cortex in humans. Here we report electrophysiological correlates of these shifts and examine whether their timing may vary for different trial sequences. On each trial, subjects monitored for a brief signal, and after a cue to respond indicated its presence or absence. Analyses focused on shifts from ongoing monitoring (correct rejection trials) to signal detection (hit trials). Trial-sequence specific analyses differentiated hits preceded by correct rejections (CR-hits) from hits preceded by hits (hit-hits). Specifically, signal-evoked P300 amplitude was larger for CR-hits than hit-hits, reflecting a shift from ongoing processing to stimulus-driven attention and response. Interestingly, the opposite pattern occurred at the response cue: Here, P300 amplitude was smaller for CR-hits than for hit-hits. This decrease suggests fewer attentional resources are necessary at the response period for signals that direct shifts from endogenous to exogenous processing modes. Further analysis will test whether CR-hits are associated with enhanced power in the gamma spectrum, as our rodent studies indicate that gamma power and acetylcholine release increase in prefrontal cortex for CR-hits relative to hit-hits. Findings from the current study will contribute to a more precise understanding of the neural mechanisms of processing mode shifts integrating multiple methods and species.

G6

SIMULTANEOUS EEG/FMRI OF TOP-DOWN ATTENTIONAL CONTROL AND PRE-TARGET BIASING OF SENSORY CORTEX Jessica Green[1], Carsten Boehler[1], Kenneth Roberts[1], Ling-chia Chen[1], Ruth Krebs[1], Allen Song[1], Marty Woldorff[1]; [1]Duke University — Numerous neuroimaging studies of top-down attentional control have shown activations in frontal and parietal cortex associated with the cued voluntary shifting of visual attention, typically accompanied by spatially-specific modulations of activity in sensory cortex that are thought to reflect biasing of those sensory-processing regions that will process a subsequent expected target. The oft-noted downside of fMRI, however, is its poor temporal resolution, making it difficult to disentangle the set of cognitive processes that occur during a shift of attention. The high temporal resolution of EEG can help determine when processes occur, such as showing fronto-parietal control activity preceding sensory biasing, but with fairly limited neuroanatomical spatial precision. Linking the fMRI and EEG activities has been difficult, typically relying on recordings acquired in separate sessions and source-modeling estimations of the EEG. Here, we simultaneously recorded EEG and fMRI activity and examined their single-trial covariation during spatial shifts of attention. Using specific facets of the cue-elicited EEG activity as regressors for the corresponding cue-elicited fMRI responses, we found slow-wave ERP components that covaried with frontal and parietal fMRI responses during the shifting of attention. In addition, lateralized posterior modulations of pretarget alpha-band oscillatory EEG activity covaried with lateralized modulations of occipital fMRI activations. This approach shows great promise in enabling the linking of different aspects of the high-temporal-resolution EEG to the corresponding fMRI responses, independent of, and/or in addition to, any source-modeling analyses, thereby helping to delineate the temporal cascade of neural activity associated with the top-down attention control of sensory processing.

G7

ALPHA-BAND OSCILLATIONS DISTINGUISH ENDOGENOUS AND EXOGENOUS ATTENTIONAL INFLUENCES Sylvia Guillory[1], Lisa Payne[1], Robert Sekuler[1]; [1]Brandeis University — Endogenous and exogenous attentional mechanisms differ along several dimensions, suggesting differences in their underlying neural processes. We devised a visual memory task in which exogenous and endogenous attentional processes might exert distinct influences, and exploited alpha band oscillations as a marker of attention. Differences in phase synchrony and alpha band power at critical points during the task distinguish endogenous and exogenous attentional influences. Subjects (n=12) performed a visual-attention task while EEG signals were recorded using a high-density electrode system. On each trial, subjects saw two briefly-presented Gabor stimuli. A visual cue immediately before each Gabor instructed the subject whether that Gabor should be attended to or ignored. After seeing both Gabors, the subject reproduced the spatial frequency of the attended Gabor. Importantly, the presentation of the unpredictable cue for the first Gabor rendered the cue for the second Gabor redundant. Consequently, attention to or ignoring that second Gabor could draw on a strongly endogenous component as subjects would have a reliable expectation about whether it should be attended or ignored. ? The power of alpha oscillations recorded from posterior electrodes significantly differed during the presentation of the first and second cues. Specifically, during a trial's second cue, there was a relative increase in alpha power, reflecting attention's endogenous component. As a subject's expectation becomes more dependable, the associated increase in posterior alpha reflects a reduced dependence upon exogenous, event-driven information, and greater reliance on exogenous information.

G8

MODELING THE INTERACTION BETWEEN DISTRIBUTED SPATIAL ATTENTION SIGNALS AND GAMMA-BAND STEADY-STATE VISUAL EVOKED RESPONSES IN SIMULTANOUSLY RECORDED EEG/MEG. Samuel Thorpe[1], Siyi Deng[1], Javier Garcia[2], Ramesh Srinivasan[1]; [1]University of California, Irvine, [2]University of California, San Diego — Recent studies suggest that spatial attention increases gamma-band (>20 Hz) synchronization in local neural assemblies processing visual stimuli at the attended location, thereby facilitating binding of information into coherent percepts. Additional studies have shown that deployment of attention to one side of visual space results in lateralization of band-specific EEG activity over symmetric parietal, occipital, and motor areas. Our goal was to determine how these lateralized attention-related signals interact with local visual populations, which presumably have resonant frequencies in the gamma band. In this study we use frequency tagging methods to localize gamma-band sensory responses to attended/unattended visual stimuli recorded using simultaneous EEG/MEG. At the start of each trial the subject was cued to attend left, right, or switch. The subject then observed a pair of dynamic stimuli presented in symmetric left/right visual hemifields, one which flickered at 20 Hz, the other at 30 Hz. The stimulus in each hemifield consisted of a circular region containing a field of randomly oriented bars- a novel bar-field was presented on each flicker cycle. Subjects were asked to detect/ignore targets in the attended/unattended fields, which were bounded by green/red annuli. On switching trials these annuli switched colors at random intervals, prompting the subject to switch attention to the opposite hemifield. These stimuli evoked responses which localized to occipital areas and increased in magnitude when attended. We used these data to develop a

statistical model of the interaction between attention-related signals (isolated in response to attentional switches) and the local steady-state gamma-band response.

G9

THE SPOTLIGHT OF SELECTIVE ATTENTION MAY CONTROL APPARENT MOTION Yangqing Xu[1], Satoru Suzuki[1], Steven Franconeri[1]; [1]Northwestern University — When two stationary objects are presented in succession at different locations, they can be perceived either as two flickering objects, or as two objects switching between the two locations (apparent motion). Previous research suggested a link between apparent motion and attentive tracking (Cavanagh 1992; Verstraten, Cavanagh, & Labianca, 2000; Verstraten and Ashida, 2005), such that the correspondence problem of what went where may be determined by the position of spatial selection over time. We tested this possibility by tracking the position of spatial selection using an electrophysiological correlate (Contralateral Delay Activity; Vogel and Machizawa, 2004). Participants were presented with an ambiguous apparent motion display (6 frames, 3Hz) that included two objects. The display could be perceived as either vertical oscillations occurring separately within each visual hemifield, or long-range horizontal motion in which an object appeared to move across the left and right visual hemifields. When the horizontal motion was perceived, attention was locked to one of two objects and shifted back and forth as the selected object appeared alternatively at the two locations. Our results provide electrophysiological evidence suggesting that the spotlight of selective attention plays an important role both in generating long-range translational motion and in maintaining the identity of an object as it moves over space and time.

G10

STIMULUS CONTEXT VIOLATES SPATIAL ATTENTION: EFFECTS OF REGION COMMONALITY ON ATTENTIONAL SELECTION Yuji Yamada[1], Tetsuko Kasai[1], Ryuji Takeya[1], Yasuko Okumura[1]; [1]Hokkaido University — Generally, spatial attention prioritizes the processing of task-relevant information. However, when attention is directed to one of two stimuli with perceptual grouping factors, it is guided automatically to the other stimulus. This study examined the case of region commonality, with or without a bounded region, using event-related potentials (ERPs).Stimulus conditions consisted of two letters, one in each hemifield, which were encircled by an oval (common condition) and by two semiellipses aligned like Greek x-shape (uncommon condition). ERPs were recorded from 12 participants who were covertly attending to one hemifield while ignoring the other during rapid stimulus presentations. The task was to detect an infrequent target letter at the attended hemifield.The typical ERP attention effects (i.e., amplitude enhancement at occipito-temporal electrodes contralateral to attended visual fields) were assessed. The early and late P1 attention effects (80-105 ms; 105-130 ms) reduced for the uncommon condition, compared to the common condition. Especially, the early P1 effect was reversed (i.e., enhanced amplitude at the ipsilateral rather than contralateral electrode) with respect to the typical P1 attention effect. The N1 attention effects (150-200 ms) were also reversed for the both conditions, the extent of which was greater for the common condition.The result of N1 indicates that region commonality guides attention via the same selection mechanism that has been found in previous studies for connectedness and color similarity. The result of P1 was unexpected, which suggests that there exist some aspects of stimulus structure that cause an early attentional guidance.

G11

EXPRESSION OF FACILITATION AND SUPPRESSION IN VISUAL SELECTIVE ATTENTION IN ADHD: AN EVENT RELATED POTENTIAL STUDY Jane Couperus[1], Dylan Furlong[1], Katherine Mott[1]; [1]Hampshire College — Research surrounding selective attention in those with attention deficit disorder (ADHD) often suggests that it functions similarly to controls (e.g. Huang-Pollock, et al. 2005) and instead the problems with attention result from deficits in sustained attention and inhibition (e.g. Barry et al., 2001). Studies that do suggest deficits, point to deficits in the neurological mechanisms underlying selective attention such as differences in facilitation during early visual processing (Perchet et al., 2001). However, these studies have not examined preparatory activity related to facilitation, nor have they looked at the contributions of suppression in either preparatory or stimulus processing. Thus this study examined the functionality of these mechanisms in 30 adults with and without ADHD using a spatial cueing paradigm. We examined target and distracter processing as a function of the expectancy of distracter presence versus absence using event related potentials. Participants were cued to the spatial location of a target (100% valid cues) as well as to the presence or absence of distracters in the opposite hemifield (70% valid cues). Analysis of distracter-present displays for all participants showed that in addition to relative enhancement of the occipital P1 in the hemisphere contralateral to the target, processing contralateral to distracters was reduced when a distractor was anticipated compared to when it was not (appearing stronger at P7/P8 than O1/O2 for those with ADHD). Moreover, distractor related suppression was seen in the preparatory frontal ADAN component for controls, but only facilitation was seen for those with ADHD suggesting possible differences in processing mechanisms.

G12

OMISSIONS, SUBSTITUTIONS AND ADDITIONS: NEGLECT DYSLEXIA IN A WORD READING TASK Roberta Ronchi[1,2], Lorella Algeri[3], Laura Chiapella[3], Marcello Gallucci[1], Maria Simonetta Spada[3], Giuseppe Vallar[1,2]; [1]University of Milano-Bicocca, Department of Psychology, Milano, Italy, [2]Neuropsychological Laboratory, S. Luca Hospital, IRCCS Italian Auxological Istitute, Milano, Italy, [3]Azienda Ospedaliera "Ospedali Riuniti di Bergamo", Bergamo, Italy — Neglect dyslexia consists in a reading task disorder, in which neurological patients make errors in the contralesional part of the letter strings. Some studies investigated the presence and the type of reading neglect errors, examining their association with other defective manifestations of unilateral spatial neglect (USN). However no studies have analyzed the relationship between different productive symptoms in neglect patients. This experiment investigated the incidence of various forms of reading errors in patients with USN showing perseverative symptoms in cancellation tests; secondly we verified whether the presence of neglect dyslexia is associated to a more severe USN in conventional tests. Fifty-two right-brain-damaged neglect patients (27 out of 52 with neglect dyslexia, 12 of them without perseveration and 15 of them with perseveration) were given target cancellation (letter and star) and word reading tasks. Results indicated that patients with neglect dyslexia and perseveration produced more substitution than omission and addition reading errors. No prevalence of one type of reading error in non-perseverating patients was found: however the tendency of this group is to produce more omission errors. Finally the neglect dyslexia subgroup showed a more severe ipsilesional bias in target cancellation tests, supporting the view that a ipsilateral reading disorder may be present in patients with a greater attentional deficit. In conclusion, perseveration seems to be mainly associated with substitution errors in patients with neglect dyslexia: as substitution represents an active re-elaboration of the contralesional part of the verbal target, this error may be considered a "productive" reading disorder.

EMOTION & SOCIAL: Emotion-cognition interactions

G13

EMOTION, EMTNOOI, EMITOON? -EMOTIONAL DIFFERENTIATION PRECEDES WORD-PSEUDOWORD DIFFERENTIATION DURING READING Johanna Kissler[1,2], Cornelia Herbert[2,3]; [1]University of Bielefeld, Bielefeld, Germany, [2]University of Konstanz, Konstanz, Germany, [3]University of Würzburg, Würzburg, Germany — During reading the cortical processing of emotional words differs from the processing of neutral words. The present study examines the functional stages of visual word processing where this differentiation occurs. Positive, negative, and neutral nouns

where intermixed with letter strings and pseudowords and presented in random sequence to student participants while their EEG was recorded. The timing and spatial distribution of differences between words, pseudowords, and letter strings on the one hand and positive, negative, and neutral words on the other hand was determined. Effects of word type occurred from 180 ms after stimulus presentation, first differentiating according to word form letter strings and from pseudowords and words, and then also differing between words and pseudowords, with effects occurring predominantly over left occipito-temporal regions. Emotion effects largely followed and paralleled this formal differentiation, starting from about 210 ms after stimulus presentation and differentiating emotionally positive and negative from neutral words over primarily left occipito-temporal regions. However, specifically for negative words, earlier left occipito-temporal effects also occurred between 110 and 140 ms. Results demonstrate that during reading emotion effects occur robustly at a lexical processing stage, but that specifically for negative stimuli pre-lexical effect are also found.

G14

THE VOCAL EXPRESSION OF EMOTION: INVOLVEMENT OF THE AFFECT/MOTOR INTERFACE OF THE BRAIN Michel Belyk[1], Steven Brown[1]; [1]McMaster University — Affective prosody is the expression of emotion in speech. Emotion is encoded by modulation of vocal pitch, loudness and speech rate. Animal models of emotional vocalizations suggest that separate pathways produce innate/emotional vs. learned/linguistic vocalizations (Jürgens, 2009). Such models posit that pathways originating in the cingulate cortex are associated with emotional vocalizations whereas pathways originating in the primary motor cortex are associated with speech. The analysis of prosody in neuroimaging studies has focused on perceptual tasks thus far, and there have been virtually no studies of the production of prosody. We examined this issue with functional MRI by studying the production of exclamations (e.g., Yay!, Damn!) compared to a series of control tasks (including producing semantically-neutral words or vocal sweeps). Beyond showing activation in the motor cortex and auditory areas, the results revealed the importance of brain areas that sit at the interface between motor function and emotion, including 1) the anterior insula/frontal operculum, 2) the "motor" and "affective" divisions of the anterior cingulate cortex, and 3) the dorsal/motor and ventral/reward divisions of the basal ganglia. Contrary to predictions generated from animal models, affective prosody might be an intrinsic component of the speech-production mechanism, rather than an add-on to it mediated by a separate emotion system. Reference: Jürgens, U. (2009). The neural control of vocalization in mammals: A review. Journal of Voice, 23, 1-10.

G15

BRAIN ACTIVITY RELATED TO EMOTIONAL AGENCY CORRELATES DISPARATELY WITH DIFFERENT POSITIVE REINFORCEMENT TRIALS OF THE IOWA GAMBLING TASK Matthew Jerram[1], Alexandra Hernandez-Vallant[1], David Gansler[1]; [1]Suffolk University — Emotional agency is the degree to which someone feels capable of acting on the environment in response to emotion. The Iowa Gambling Task (IGT) was designed to measure emotional decision-making, related to agency. Two of the four response choices of the IGT are rewarding, with different schedules; Deck C rewards at a higher frequency while Deck D rewards at a higher magnitude. This study examined how brain activity in response to high agency stimuli is related to performance on IGT reward trials; it was hypothesized that the reward schedules of Decks C and D would correlate differently with brain activity. Functional MRI (fMRI) was performed on thirteen right-handed men (age range = 20-35) while they viewed images from the International Affective Picture System (IAPS), chosen based on normative agency ratings. Participants viewed high and low agency images in a block design. Participants also completed a computerized version of the IGT. Data were analyzed using Statistical Parametric Mapping (SPM8). Contrasts for high-low agency were created and whole-brain regression analyses were performed in SPM8. A focus of positive correlation between activation and Deck C was found in the cerebellar tonsil. A focus of positive correlation between activation and Deck D was found in the posterior cingulate. No negative correlations were found. Activated regions correlated with high frequency reward are associated with formation and storage of emotional responses while regions correlated with high magnitude reward are associated with error recognition and memory retrieval. These results offer insight into neural-emotional components of reward responses.

G16

EMOTION CONTROL MECHANISMS: SHARED NEURAL ARCHITECTURE OF SUPPRESSION AND REGULATION Zain Sultan[1], Erin Lightman[1], Regina Schmidt[2], Eric H. Schumacher[1]; [1]Georgia Institute of Technology, [2]Air Force Research Laboratory, Wright-Patterson Air Force Base — The ability for humans to actively control their emotions is essential to successful functioning in daily life. Control is achieved through the use of a wide variety of strategies, including suppression and regulation. Both of these strategies have been extensively studied individually, but their relationship has yet to be investigated within the same experiment. Neuroimaging evidence converges on the involvement of the dorsolateral prefrontal cortex (dlPFC) and anterior cingulate cortex (ACC) for both of these emotional control strategies. Additionally, decreased activation in the amygdala during suppression has also been reported. In the current study, participants viewed IAPS images under either suppression, regulation, or control instructions. Data indicate that both strategies effectively reduced participants' emotional response to the IAPS images and resulted in similar patterns of activity. Specifically, activity increased in the dlPFC and ACC and decreased in the amygdala. These data indicate that these seemingly distinct emotional control strategies may be supported by similar underlying cognitive mechanisms and may be supported by more general executive control processes.

G17

EFFECTS OF MEDITATION ON THE TIME COURSE OF NEURAL CORRELATES OF PAIN PERCEPTION David Perlman[1,2,3], Richard Davidson[1,2,3], Andrew Schoen[2], Antoine Lutz[1,3]; [1]Waisman Laboratory for Brain Imaging and Behavior, University of Wisconsin–Madison, [2]Department of Psychology, University of Wisconsin–Madison, [3]Center for Investigating Healthy Minds, University of Wisconsin–Madison — A growing body of functional magnetic resonance imaging (FMRI) and other research on the neural correlates of mindfulness meditation, acceptance, and pain perception shows that an intentionally practiced attitude of openness leads to improvements in the affective response to nociceptive stimuli. We implemented a novel FMRI paradigm for studying affective chronometry in a large cohort of 109 community participants and 26 meditation practitioners. A thermal nociceptive stimulus was preceded by a cued anticipation period and followed by 18 seconds of uninstructed recovery time. Consistent with previous findings from our lab and others, meditators reported lower pain unpleasantness ratings compared to non-meditators. During the middle epoch of recovery, meditation practitioners showed greater activity in the anterior insula compared to non-meditators. We also present novel software tools for visualizing time-dependent FMRI data, for investigating affective chronometry.

G18

OSCILLATORY CHANGES IN VISUAL CORTEX DURING EXCITATION AND INHIBITION OF FEAR CONDITIONING Vladimir Miskovic[1], Andreas Keil[1]; [1]University of Florida — Fear excitation and inhibition have been studied in humans and non-human animals using conditional discrimination procedures (abbreviated as AX+/BX-). We recorded steady-state visual evoked potentials using dense–array electroencephalography (EEG), while participants performed a version of the AX+/BX- task designed to encourage the elemental processing of conditioned stimuli: Cues A and X presented together signaled an aversive stimulus (a white noise burst at 92 dB sound pressure level), while cues B and X predicted the absence of an aversive outcome. On subsequent trials, A and B cues were paired to assess the competitive dynamics between learned threat and safety signals. Additionally, A and C trials were included to control for nov-

elty-related effects. The conditioned stimuli were Gabor patches luminance modulated at two distinct frequencies in order to separate the active neural networks in visual cortex. Online assessments revealed that most participants were able to successfully acquire contingencies associated with the elemental cues. Steady state visual evoked amplitudes increased following conditioning of both the excitatory (A+) and inhibitory (B-) stimuli. The simultaneous presentation of A and B cues produced relative cortical facilitation at both oscillatory frequencies. The introduction of an associatively novel element (C) led to competition with electrocortical processing of the previously conditioned stimulus. Our study provides additional insight into the brain dynamics associated with learning and responding to signals of danger and safety.

G19

MIND WANDERING ATTENUATES EMOTIONAL PROCESSING Julia Kam[1], Judy Xu[1], Tasha Cheong[1], Todd C. Handy[1]; [1]University of British Columbia — Mind wandering has been shown to reduce both cognitive and sensory level processing of incoming stimuli. However, it is currently unclear whether mind wandering attenuates emotional processing as well. To address that question, this study examined whether mind wandering reduces our empathetic response to painful-looking stimuli using an experience sampling approach. Participants were presented with photos of hands in painful and non-painful/neutral situations and asked to state whether they considered the situation to be painful or not painful, while event-related potentials (ERPs) were recorded. At random intervals, participants were asked to report whether they were on-task or mind wandering. The ERPs to the photos were then examined as a function of attention state, that is, whether or not they immediately preceded a report of on-task versus mind wandering. Our data revealed that painful photos were processed to a greater extent than neutral photos during periods of on-task, which is consistent with previous research. However this difference was absent during periods of mind wandering. We confirmed this in a second behavioral experiment in which participants rated the painfulness of the situation in photos on a 5-point scale, and found that the behavioral ratings for painful vs neutral photos were significantly different during periods of on-task, but not mind wandering. Taken together, our results provide behavioral and electrophysiological evidence suggesting that the impact of mind wandering extends to emotional processing such that it reduces our emotional response to painful stimuli.

G20

DISSOCIABLE NEURAL NETWORKS SUPPORT DISTINCT COMPONENTS OF AVERSIVE ANTICIPATION Dan Grupe[1], Desmond Oathes[1,2], Jack Nitschke[1]; [1]University of Wisconsin-Madison, [2]Stanford University — The anticipation of future adversity confers adaptive benefits by engaging myriad preparatory mechanisms, but when conducted in excess can also be maladaptive. Specifically, exaggerated anticipation of potential negative events is a central cross-diagnostic feature of all clinical anxiety disorders. Neuroscientiifc investigations have largely treated anticipation as a unitary process, but we show here in an fMRI study of 42 healthy adults that distinct phases of aversive anticipation are associated with dissociable neural mechanisms. Immediate anticipatory activity in response to a cue predicting aversive pictures was seen in regions associated with threat detection and associative value representation, including the orbitofrontal cortex, amygdala, and pregenual anterior cingulate. During the subsequent sustained anticipatory period, activation was observed in the bed nucleus of the stria terminalis, anterior insula, anterior mid-cingulate (aMCC), and midbrain/periaqueductal gray, regions associated with anxiety, interoception, and defensive behavior. PPI analysis revealed enhanced aMCC-midbrain coupling specifically during sustained anticipation of aversive events, suggesting that this preparatory defensive circuit plays a key role in anticipatory processing. Individual differences analyses revealed associations between elevated anxiety symptoms and early anticipatory activity in the amygdala and aMCC. These results provide a comprehensive description of dissociable neural circuitry associated with distinct phases in the anticipation of aversive events. The observed associations between anxiety symptoms and increased anticipatory activity in these neural circuits, together with previous reports implicating many of these regions in pathological anxiety, suggest that the implementation of similar models in clinical populations may provide insight into the neurobiological correlates of aberrant anticipatory activity.

G21

TAKING THE PLUNGE: AN INVESTIGATION OF PLEASANT FEAR AND OTHER ATYPICAL EMOTIONS Christine Wilson-Mendenhall[1,2], Lisa Feldman Barrett[1,2], Lawrence Barsalou[3]; [1]Northeastern University, [2]Massachusetts General Hospital, Harvard Medical School, [3]Emory University — There is incredible variety in human emotions. Fear, for example, might be experienced when an individual is frantically trying to escape a blazing fire, rocketing downwards in a rollercoaster car, warily opening a credit card bill, or stepping out on a first date. We examined if familiar, atypical instances of an emotion category (e.g., pleasant fear of thrill-seeking) are processed differently in large-scale brain networks than familiar, typical instances of an emotion category (e.g., unpleasant fear of violent acts). The "default" network identified during resting state scans has been implicated in many facets of social cognition, yet the functions of this network remain unclear. We predicted that greater activation would be observed in the default network when participants imagined experiencing atypical instances of emotions (as compared to typical instances) due to the increased socioemotional inference underlying self-projection into the situation. In a novel fMRI paradigm, participants immersed themselves in an atypical or typical fear, sadness, or happiness emotion scenario during each trial. As compared to typical instances, greater activation was observed for atypical instances of the emotions in midline regions of the default network (dorsal medial prefrontal cortex and posterior cingulate) as well as bilateral temporoparietal junction, left temporal pole, and lateral frontal regions associated with executive function. No brain region was more active for typical relative to atypical instances of emotion. Future research is necessary to understand the specific features of atypical emotion instances (e.g., ambiguity, complexity, etc.) that underlie the heightened activity observed.

G22

ONCE YOU FEEL IT YOU SEE IT. NEURAL BASES OF CONSCIOUS AND NON-CONSCIOUS PERCEPTION OF FEARFUL BODILY EXPRESSIONS IN HEMISPATIAL NEGLECT Marco Tamietto[1,2], Franco Cauda[2], Katiuscia Sacco[2], Giuliano Geminiani[2], Beatrice de Gelder[1,3]; [1]Tilburg University, [2]University of Torino, [3]MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging — Fearful bodily expressions modulate spatial attention and enhance visual awareness in patients with hemispatial neglect, who often fail to perceive consciously the stimuli in the left-side space. Here we investigated in a behavioral/fMRI study the neural correlates of conscious and non-conscious perception of bodily expressions. Instrumental (neutral) e fearful expressions were presented either singly in the LVF or RVF, or bilaterally with displays containing a right-side neutral expression paired with either a left-side neutral or fearful expression. The neural correlates of non-conscious perception were assessed by contrasting bilateral trials with neglected left-side fearful bodies with unilateral trials where only a right-side neutral body was presented (and detected). The contrast revealed activity in emotion-sensitive areas (amygdala and vmPFC), perceptive areas (FG, EBA, PCC), in the temporo-parietal junction implicated in attentional shift, and in premotor areas. Conscious perception in bilateral trials in which a left-side fearful body was successfully detected was contrasted to the same trials in which, however, the left-side fearful body was neglected. Results showed a significant activation of sensory-motor areas, anterior insula and cerebellum. Our findings show neural processing of non-consciously perceived fearful bodies and suggest a key role of interoception and sensory-motor processing in visual awareness.

EXECUTIVE PROCESSES: Working memory

G23

PROCESSING SPEED AND VERBAL WORKING MEMORY IN CHILDREN AND ADULTS: A DEVELOPMENTAL ERP STUDY Melisa Carrasco[1], Jennie K. Grammer[2], William J. Gehring[2], Frederick J. Morrison[2]; [1]Neurosci. Grad. Program, Univ. of Michigan, Ann Arbor, MI, [2]Dept. of Psychology, Univ. of Michigan, Ann Arbor, MI — A growing literature has suggested that improvement in children's working memory (WM) ability follows a systematic developmental progression. Relatively little research has been done to describe the electrophysiological correlates of development of WM using event-related potentials (ERPs). The purpose of this study was to assess age-related differences in the fronto-central negativity (FCN), an ERP that is responsible for supporting working memory and manipulation processes, among a group of children ages 5-7 years old. Specifically, children were asked to attend to a sequence of numbers and objects. After stimulus presentation, participants were asked to recall the 1st or 2nd object (or number). Preliminary results showed that, in children ages 5-7 years old, there was a trend for a difference in FCN amplitude between the "thinking of the things" (M= 6.486, SD= 35.001) vs. "thinking of the numbers" condition (M= 28.234, SD= 49.218), $t(10)=2.152$, $p=0.057$; this phenomenon corresponds with participants' self report of increased task difficulty with respect to the ability to hold in memory the object representations (vs. the numbers). To our knowledge, this study is the first to isolate the FCN in children this young using a WM task. In order to place this data within a larger context of development, a second goal of this study was to determine the mechanistic differences underlying working memory in children and adults performing the same WM task. Preliminary behavioral and ERP data from 20 children and 20 adults will be described as part of this presentation.

G24

REDUCED DORSOLATERAL PREFRONTAL CORTEX ACTIVATION DURING ATTENTIONALLY-GUIDED SPATIAL WORKING MEMORY PROCESSING Maren Strenziok[1], Michael Chung[1], Pamela Greenwood[1], Sophia Santacruz[1], Raja Parasuraman[1]; [1]George Mason University — Functional neuroimaging studies have shown that visuospatial attention and visual working memory engages overlapping neural networks in dorsolateral prefrontal (dlPFC) and superior parietal cortex. Thus, activation in these areas should vary with cue-driven attentional guidance during working memory (WM) tasks, depending on the precision of the cue in guiding spatial attention. Although target pre-cueing increases the success of target maintainance in WM, cue-driven brain activation changes during WM have not been studied. We assessed changes in brain activation during WM performance under cue-driven attentional guidance and in the presence or absence of distraction. Participants had to remember the location of target dots for 3s and judge whether a test dot matched target dot location (target-test-distance: 0°, 2°, or 4°). Targets were preceded by either no cue or a 500ms circular cue that provided either relatively precise (5.2°) or relatively imprecise (8.1°) attentional guidance. On 50% of the trials, small distracter circles appeared during the delay. A 3x2 (cue size x distracter presentation) ANOVA computed on brain activation changes during the delay revealed lower brain activation in the right dlPFC when the cue was presented compared to cue absence. Presence of distracters lead to greater activation in the left insula compared to distracter absence. Finally, the dlPFC, ventral prefrontal, superior temporal, and occipital cortices were sensitive to the interaction between cue size and distracter presence. Our results indicate that attentional guidance reduces the neural cost on WM performance, whereas reorienting associated with distraction during retention reduces the efficiency of brain function.

G25

OSCILLATIONS AND MEMORY FOR ORDER: SUPPORT FOR THE THETA/GAMMA HYPOTHESIS Jeremy Caplan[1], Michelle Chan[1], Yang Liu[1]; [1]University of Alberta — Theta oscillations, 4-8 Hz rhythms, are thought to function as reference waves that can store items, represented in faster, gamma-oscillation cycles, in precise sequences. This phase-coding hypothesis has mainly been supported for the hippocampal contribution to rat spatial learning (starting with O'Keefe and Recce, 1993). Two human EEG studies found theta oscillations linked to order-memory specifically, both with an individual-differences approach (Caplan and Glaholt, 2007; Hsieh et al., 2011). We hypothesized that if the theta/gamma mechanism functions in human memory, then the presence of theta and gamma during specific study trials should be associated with fast response times (within-subjects). To directly test memory for order, one can use the judgement of relative order (JOR) paradigm. Twenty-five participants studied lists of four consonants, each followed by one JOR probe. A probe was a pair of items from the list, and the target was the probe-item that had occurred earlier in the list. Using the Better OSCillation detection method (BOSC; Caplan et al., 2001) which corrects for coloured-noise bias across frequency and seeks oscillations lasting at least three cycles, we computed correlations between log-odds-transformed proportion-of-trial measures of oscillations from 1-54 Hz and response time across correct trials (average of 185 trials/participant). These correlations (Fisher-transformed) were tested for reliability across participants. At Pz, overlying parietal areas that have been implicated in JORs (Marschuetz, 2005), correlations were significantly negative, within the theta and gamma bands only ($p<0.05$), suggesting that within-subject fluctuations in a theta/gamma mechanism exert an immediate influence on order-memory judgements.

G26

WHITE MATTER MICROSTRUCTURE PREDICTS PERFORMANCE ON A MODIFIED VERSION OF THE PASAT IN AN ADOLESCENT POPULATION Jill Waldman[1,2], Megan Herting[1], Susan Li[2], Bonnie Nagel[1]; [1]Oregon Health & Science University, [2]Pacific University — The Paced Auditory Serial Addition Test (PASAT) is a measure of executive functioning that requires processing speed, inhibition, and working memory. These high-level functions are subserved by distributed fronto-parietal brain networks. Diffusion tensor imaging (DTI) is an in vivo imaging technique used to characterize white matter (WM) microstructure in the brain, with greater WM integrity relating to improved executive functioning. Given the complex and functionally integrated nature of the PASAT, we hypothesized that WM microstructure, particularly in connections between frontal and parietal cortices, would be associated with better PASAT performance. Thus, we examined the relationship between PASAT 3.0 seconds (s) and 2.0s performance and WM microstructure in 88 adolescents (48 girls; mean age=13.2, SD=1.7). DTI and PASAT data were collected, and fractional anisotropy (FA) was used to assess WM integrity. FA is a DTI outcome that measures restricted water diffusion, with higher values reflecting greater myelination and intravoxel fiber-tract coherence. Using Tract Based Spatial Statistics, voxelwise regression analyses were performed to examine the relationship between PASAT performance and FA, controlling for age (voxel and clusterwise thresholded, $p < .01$). We found that PASAT 3.0s performance was positively correlated with FA in the right posterior superior longitudinal fasciculus (SLF), and more rapid PASAT 2.0s performance was positively correlated with right central SLF FA. These results suggest that the integrity of fronto-parietal WM is important for complex executive functioning during adolescence. Given maturation of executive skills and WM across adolescence, these findings hold potential implications for brain and behavior relationships during development.

G27

A BEHAVIORAL AND FMRI INVESTIGATION OF THE INFLUENCES OF TASK-DEMAND AND STRATEGY ON THE FOCUS OF ATTENTION Alexandra Morrison[1], Andrew R.A. Conway[2], Jason M. Chein[1]; [1]Temple University, [2]Princeton University — An ongoing debate concerns how many distinct mental representations can be maintained in the focus of attention. Prior work indicates superior performance and distinct neural correlates for the final item presented in a list of items in short-term memory tasks. This is interpreted as evidence for a single item focus of attention and contradicts evidence demonstrating a focus of attention of several items. The current experiments investigate how task-demands and strategy-use influence correlates of the focus of attention. In an initial behavioral experiment, performance and self reported strategy were measured in two tasks (judgment of recency, judgment of primacy), in two domains (verbal, spatial). Results replicate the recency effects found in earlier studies, and also, demonstrate a retrieval advantage for the earliest possible probe indicating a primacy effect. Importantly, a larger recency effect was present in judgment of recency while a larger primacy effect was present in judgment of primacy. Self reported strategy-use had little effect on behavioral performance. In a follow-up fMRI experiment, participants completed verbal judgment of primacy and judgment of recency and were probed about self-report strategy. Analysis compares retrieval of items presented in different serial positions and reveals that early and late items differ in engagement of regions associated with both maintenance and retrieval of information. These patterns are compared across task and strategy. Together these results inform the hypothesis that the retrieval advantage of particular items in short-term memory tasks is influenced by task demands and is not necessarily tied to recency.

G28

NEURAL CORRELATES OF TASK SWITCHING IN A LARGE COMMUNITY POPULATION Joey Contreras[1], Angelica Bato[1], Eliza Congdon[1], Katie Karlsgodt[1], Russ Poldrack[1], Edythe London[1], Robert Bilder[1], Fred Sabb[1]; [1]University of California Los Angeles — Cognitive control is defined as the ability to rapidly and flexibly adjust behavior to changing environmental demands. This latent faculty is complex and is considered to be multi-faceted. Aspects include working memory, attention, and problem solving. One particularly effective way to examine these processes is through a Task Switch Paradigm. However, alternating between two tasks impairs performance, as indicated by increased reaction times (RT's) and higher error rates. This impaired performance, termed "switch cost," can be reduced through advance preparation and better retention of task instructions. Therefore, we hypothesized that having a highly efficient working memory would lower switch costs. To test this, sixty participants underwent fMRI analysis on a Siemens 3T Trio as part of the Consortium for Neuropsychiatric Phenomics study. The participants performed a cued color/shape task-switching paradigm as part of a larger battery of tests including the Digit-Span and Color-Trail tests. Data were processed and analyzed with a mixed model using the FSL suite. Preliminary analyses reveal that a network of regions typically associated with cognitive control were active during task performance. Greater activity was seen for Switch Trials compared to Non-Switch Trials in bilateral prefrontal and posterior parietal regions, the basal ganglia, and anterior and poster cingulate. Digit-span performance was significantly correlated with right prefrontal activity for Switch Trials minus Non-Switch Trials .. These data suggest that working memory span is associated with item switching. Further analyses are underway to examine this association in detail.

G29

STRENGTH OF CORRELATION IN AND BETWEEN RESTING STATE FUNCTIONAL NETWORKS IS LINEARLY RELATED TO PERFORMANCE ON A VARIETY OF COGNITIVE TASKS Matthew Magnuson[1], Garth Thompson[1], Hillary Schwarb[2], Brian Roberts[2], Wenju Pan[1], Andy McKinley[3], Lloyd Tripp[3], Eric Schumacher[2], Shella Keilholz[1]; [1]Emory University / Georgia Institute of Technology, [2]Georgia Institute of Technology, [3]Air Force Research Laboratory, Wright-Patterson — Intrinsic functionally connected brain networks (FCNs) are spatially distinct brain regions that share a similar functional signal. Activity in these FCNs can be measured using functional magnetic resonance imaging (fMRI). FCNs are thought to facilitate efficient processing and intercommunication between cooperating brain regions. In this work the possibility of FCN activity influencing cognitive performance is explored. 16 healthy subjects performed cognitive performance tasks assessing attention, verbal working memory, spatial working memory, and a measure of fluid intelligence. 2-9 days after cognitive performance testing subjects underwent resting state fMRI scanning. The relationship between cognitive performance scores and the strength of resting state functional connectivity within the Task Positive Network (TPN), Default Mode Network (DMN), and the correlation between the two networks was evaluated. Increased performance on the attention task was associated with increased DMN/TPN anti-correlation; conversely, increased performance on the verbal working memory and fluid intelligence tasks was associated with decreased DMN/TPN anti-correlation. These results suggest that inherent organization between FCNs may facilitate performance on one task while being detrimental to another. Increased mean connectivity in the DMN was related to increased performance on the fluid intelligence task, while increased connectivity with the TPN was indicative of decreased spatial working memory performance. FCN data collected at rest is significantly related to a variety of cognitive performance tasks performed days before fMRI data collection. Furthermore activity in FCNs is a stable and inherent 'trait' of functional brain architecture, as opposed to a passing state, that is meaningful with respect to cognitive ability.

G30

NUMBER/RESOLUTION VS. STIMULUS COMPLEXITY: A UNIFYING ACCOUNT OF THE NEURAL CORRELATES OF VISUAL WORKING MEMORY CAPACITY Hillary Schwarb[1], Shella D. Keilholz[1], R. Andy McKinley[2], Lloyd Tripp[2], Eric H. Schumacher[1]; [1]Georgia Institute of Technology, [2]Air Force Research Laboratory — Since antiquity, philosophers and scientists have been interested in human memory; today, researchers are still working to understand its boundaries and architecture. One popular theory of working memory capacity (WMC) identifies a limit of approximately four items (Cowan, 2001). Consistent with this theory, neuroimaging research shows that activity in the intraparietal and intraoccipital sulci reflects visual WMC and reliably tracks the number of items stored (Todd & Marois, 2004). This capacity limit is not, however, universally accepted and some researchers have proposed that visual WMC is strongly influenced by the complexity of the items stored (Alvarez & Cavanagh, 2004). Furthermore, storing items of varying complexity results in distinct patterns of neural activity (Xu & Chun, 2006). Awh, Barton, and Vogel (2007) have recently proposed a unifying account of visual WMC suggesting that visual working memory is mediated by two independent factors: number (number of items stored) and resolution (amount of detail stored). It seems likely that resolution plays an important role in successful discrimination of complex items. Thus the present study seeks to directly evaluate the neural relationship between number/resolution and stimulus complexity. Results indicate that superior and inferior intraparietal sulcus activity tracks capacity estimates both for measures of number and resolution. Lateral occipital complex activity, however, tracks capacity estimates only for measures of number and remains uniformly active for measures of resolution. These data suggest that differential neural activation in the parietal and occipital lobes may reflect general number and resolution processes responsible for identifying changes among complex stimuli.

G31

BUILDING COMPLEX TASK PERFORMANCE: MEASURING UNIQUE CONTRIBUTIONS TO FLUID INTELLIGENCE FROM A SINGLE HIERARCHICALLY-NESTED TASK. Kayla Knopp[1], Jeremy Reynolds[1]; [1]University of Denver — Recent neuroimaging and neuropsychological research has suggested that some cognitive control processes may be hierarchically organized. However, there has been little investigation of how these nested control processes may relate to other constructs associated with cognitive control, such as fluid intelligence and working memory span. The current study used a sequential working memory (WM) paradigm (a modified version of the AX-continuous performance task called the ½-AX-CPT) in order to investigate this question. In some conditions, this sequential WM paradigm is conceptually equivalent to a standard AX-CPT, in which a single prior stimulus is needed to determine the appropriate response (e.g. an X following an A is a target). Other conditions require additional information that must be maintained across multiple trials, in spite of the lower-level information being updated on each trial (e.g. an X following an A is a target, but only after a 1 has been presented). In addition to manipulating whether this higher-level information was necessary, we also manipulated whether distractor stimuli occurred within a block of trials or not. Decomposition of performance on this task suggested that these two manipulations were associated with unique variance in one measure of fluid intelligence (Ravens Advance Progressive Matrices). The current work builds upon previous work establishing a link between context maintenance and WM span, and begins to establish a link between simple hierarchically nested tasks and better established psychological constructs such as WM span and fluid intelligence.

G32

INDIVIDUAL DIFFERENCES IN MENTAL MODEL UPDATING DURING NARRATIVE TEXT COMPREHENSION Marguerite McQuire[1], Seana Coulson[1]; [1]University of California, San Diego — In a series of 4 behavioral experiments, we investigated the impact of individual differences on mental model updating during reading of narrative texts. We presented short narratives that describe a protagonist as being spatially close (associated) or far away (dissociated) from a critical object, "George jogged home from work. He 'put on/took off' his faded 'sweatshirt' and decided to walk over to his girlfriend's." Half the experimental trials were followed by a filler sentence. Every narrative concluded with a sentence that anaphorically refers to the critical object, "He was sorry 'it' was torn." Participants were faster to read the final sentence when the object was described as being spatially close to the protagonist compared to when it was farther away (spatial association effect). In Experiments 1 and 2 (n=44 in each) we found the spatial association effect was positively correlated with verbal working memory capacity and mental rotation ability. Experiments 3 and 4 (n=44 in each) used a dual task paradigm to tax verbal (Experiment 3) and spatial (Experiment 4) working memory during text comprehension. Experiment 3 revealed additive effects of verbal memory load and spatial association on reading times for the final sentences. In Experiment 4, the spatial association effect was larger with high spatial load than low, especially in participants with smaller spatial working memory capacity. Consistent with grounded accounts of language comprehension, results suggest that brain systems for visuo-spatial working memory significantly impact mental model updating during narrative text comprehension.

LANGUAGE: Other

G33

DISTINCT BRAIN NETWORKS SUPPORT THE EXECUTIVE CONTROL OF EACH LANGUAGE IN LATE BILINGUALS Leila Chouiter[1], Jean-Marie Annoni[1], Lucas Spierer[1]; [1]Neurology Unit, University of Fribourg, Fribourg, Switzerland — Bilinguals show a remarkable ability to switch between languages depending on contextual demands. The inhibitory hypothesis suggests that selection of a given language notably involves inhibiting the other unused languages to prevent cross-language interferences. Current literature on executive control in bilinguals shows that the control of language may involve specific brain networks instead of relying solely on general cognitive executive mechanisms. However, whether distinct executive processes control each language remains unknown. Here, we investigate the spatio-temporal brain mechanisms supporting intra-lingual inhibition in late bilinguals with a medium-level second language proficiency. We addressed this question by contrasting electrical neuroimaging analyses of visual evoked potentials (VEPs) recorded in twelve bilingual individuals during the completion of a bilingual color-stroop paradigm with Language (First/L1; Second/L2) and Congruency (Congruent; Incongruent) as within-subject factors. Behaviorally, we observed a significant ($p>0.05$) Language x Congruency interaction driven by a larger stroop effect for L1 than L2, suggesting an easier inhibition of L2. At the electrophysiological level, we observed a significant interaction between factors Language and Congruency 420 to 445ms post-stimulus onset at the topographic level, indicative of the engagement of distinct configuration of brain networks. Distributed electrical sources analyses localized these effects within the anterior cingulate and basal ganglia, middle frontal and occipital areas. We interpret our results in terms of qualitatively distinct executive mechanisms for the control each language in late bilingual and more generally of partly segregated anatomo-functional pathways for the processing of languages acquired late in life.

G34

DTI REVEALS ASSOCIATIONS BETWEEN WHITE MATTER STRUCTURE AND READING SKILL IN TYPICAL ADULTS Suzanne Welcome[1], Marc Joanisse[1]; [1]University of Western Ontario, Centre for Brain and Mind — We explored the hypothesis that because skilled reading requires efficient coordination of distant cortical regions, variations in white matter integrity can be used to predict individual differences in reading subskills. Of interest were relationships between different aspects of reading skills and white matter structure, in typical-reading adults. We used diffusion tensor imaging and probabilistic tractography to investigate the size and integrity of white matter pathways extending from cortical regions of interest (ROIs) associated with different reading subskills. We identified ROIs using both anatomical markers and fMRI localizers. ROIs were identified subjectwise, which retained individual differences in anatomy and avoided distortions resulting from spatial normalization. Increased tract volume was associated with increased phonological decoding ability in several regions including left Heschl's gyrus and portions of the corpus callosum. Overall, the data suggest that phonological decoding ability is highest among those with more extensive anatomical connections from auditory cortex. Similar associations were not observed between these regions and either non-phonological reading measures or nonverbal IQ, indicating the specificity of this relationship. Fractional anisotropy in a separate set of regions was positively correlated with better reading comprehension and higher nonverbal IQ, including the left angular gyrus. These findings suggest that individual differences in white matter structure relate to reading abilities among adults, albeit in a complex way that respects the multifactorial nature of word recognition. Such relationships between individual differences in brain connectivity and individual differences in reading skill may shed additional light on the neural substrates of reading.

G35

EXPLORATION INTO FEEDBACK AND NON-FEEDBACK BASED LEARNING IN APHASIA Sofia Vallila[1,2], Swathi Kiran[2]; [1]Massachusetts Institute of Technology, [2]Boston University — While we have some understanding of how individuals with post-stroke aphasia relearn language, why some patients respond to treatment while others do not remains a looming question in the field of aphasia rehabilitation. Based on previous studies in normal and brain damaged populations (Knowlton et al., 1994; Davis et al., 2009; Maddox et al., 2008; Ashby et al., 2002; Filoteo et al., 2005) that have shown that factors such as training method, feedback and stimulus characteristics lead to differential engagement of neural sub-

strates, we hypothesize that patient progress with language relearning is attributable to language processing as well as to underlying cognitive systems being engaged during learning. To this end, we aimed to explore learning of novel non-linguistic categories in patients and controls, exploring two training methods hypothesized to engage distinct memory systems and neural resources. Stimuli for the experiment were cartoon animals that vary on ten binary features (Zeithamova at al., 2008) each associated with one of two categories with a fixed probability. Each participant completed feedback and non-feedback based category learning paradigms comprised of a training phase and a testing phase. Data collected from ten patients with aphasia and ten age-matched controls show that controls are equally able to learn following feedback and non-feedback based instruction. Five out of ten patients showed the ability to learn following at least one method of instruction, suggesting that learning is in fact affected in aphasia and is an important factor to consider in the field of aphasia rehabilitation.

G36

EFFECTS OF MUSICAL AND LINGUISTIC EXPERIENCE ON THE PROCESSING OF SPEECH AND NON-SPEECH PITCH: AN EVENT-RELATED ELECTROPHYSIOLOGICAL STUDY Yue Wang[1], Yang Zhang[2], Angela Cooper[1,3], Mathieu Dovan[1]; [1]Simon Fraser University, [2]University of Minnesota, [3]Northwestern University — This study addresses the extent to which speech processing involves linguistic-specific neural mechanisms or extends across lower-level sensory and higher-level cognitive processes. We examine speech and non-speech pitch processing by tone and non-tone language speakers with or without musical training, hypothesizing that, if tonal processing were linguistic-specific, neural sensitivity for tone in speech would be different for native and non-native tone language speakers, whereas non-speech tone processing would be comparable. Additionally, given that pitch perception is fundamental to both speech and music, music experience is expected to affect linguistic pitch processing. Using electroencephalography, Mandarin (tone language) and English (non-tone language) musicians and non-musicians were tested in speech (Mandarin tone) and non-speech (hummed tone) conditions. Results showed that, for the non-musicians, the Mandarin group elicited larger mismatch negativity (MMN) responses in the speech condition than the English group. Additionally, only for the Mandarin group were the MMNs for non-speech larger than those for speech. For latency, the Mandarin group showed earlier MMNs than the English group for both speech and non-speech. However, these differences became less evident for the musicians, in that the Mandarin and English musicians exhibited similar results across conditions, approximating the Mandarin non-musician patterns. The results reveal higher neural sensitivity in Mandarin listeners in both speech and non-speech conditions, indicating that language experience may lead to automatic transfer between speech and non-speech pitch processing. On the other hand, musical pitch experience may facilitate linguistic pitch processing. These results suggest interconnected brain functions across sensory, linguistic and cognitive domains.

G37

NEURAL CORRELATES OF LETTER REVERSAL IN CHILDREN AND ADULTS Li-Wei King[1], Marianna Eddy[1], Priya Kalra[2], Debbie Yee[1], Stephanie Del Tufo[3,4], Pawan Sinha[1], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Harvard Graduate School of Education, [3]Haskins Laboratories, [4]University of Connecticut — The human object recognition system typically generalizes between objects and their mirror images. Since writing systems are orientation specific, mirror generalization has to be unlearned when children learn to read. We investigated the neural correlates of letter reversal in normal reading children (age 5-12) and adults, specifically in the region in left occipital temporal cortex often called the visual word form area (VWFA). We localized a region of interest (ROI) in both groups with a separate localizer, selecting left fusiform clusters that responded more for words than for objects for each individual. We then extracted the activation while participants looked at letters and reversed letters from this ROI. We found that the VWFA in children responded equally to letters and reversed letters, whereas this area responded less for letters than reversed letters in adults. In addition, we collected event-related potentials from a subset of these participants, where we found the same pattern of sensitivity on the N170 when comparing letters and reversed letters. Specifically, the N170 amplitude did not differ between the two manipulations in the children, but did in adults (the N170 amplitude for normally oriented letters was lower than that for mirror reversed letters). These results show that the unlearning of mirror generalization for letters follows a protracted time-course extending even beyond early adolescence.

G38

RS-FCMRI BASED CHARACTERIZATION OF LEFT OCCIPITO-TEMPORAL CORTEX Alecia Vogel[1], Alexander Cohen[1], Jonathan Power[1], Steven Nelson[1], Jessica Church[1], Joseph Dubis[1], Sarah Ihnen[1], Kelly Barnes[1], Fran Miezin[1], Bradley Schlaggar[1], Steven Petersen[1]; [1]Washington University School of Medicine — Regions in the left occipito-temporal (OT) cortex are reported to show separable visual specializations; e.g., for motion (i.e., MT+, Tootell et al., 1995) and word-related processing (i.e., putative visual word form area (pVWFA), Cohen et al., 2004). Our group recently reported a region in left OT (LOT) with characteristics useful for reading but not limited to processing letters or words. To explore this issue more broadly, we defined regions in left OT cortex using fc-Mapping (Cohen et al., 2008), the relationships between those regions using community detection algorithms in resting fcMRI, and the function of those communities using the evoked response profiles to several functional tasks. fc-Mapping demonstrates 18 regions, including regions at the reported coordinates of LOT, MT+, and the pVWFA. Community detection analysis of the 18 fc-Mapping regions defined 3 major communities: 1) posterior regions showing close mutual fcMRI relationships to other visual cortical regions, 2) a set that includes LOT, MT+, and the pVWFA, preferentially correlated with the dorsal attention network (Corbetta and Shulman, 2002), and 3) a group of anterior regions related most closely to the fronto-parietal control network (Dosenbach et al., 2006, 2007). These communities show statistically different functional responses to word and attention-related tasks, demonstrating a broad functional organization in left OT cortex. While there may be separate regions related to "specialized" word and motion processing and the less specialized processing described in our recent work, such regions have similar functional relationships with control networks, and overlapping evoked functional properties.

G39

SPANISH HERITAGE LANGUAGE PROCESSING: AN ERP STUDY Harriet Wood Bowden[1], Kara Morgan-Short[2], Kim Potowski[2], Laura B. Bartlett[2]; [1]University of Tennessee-Knoxville, [2]University of Illinois-Chicago — A growing body of research has examined (morpho)syntactic similarities and differences between heritage languages (those acquired and used in a minority context), native languages (L1) and second languages (L2; Montrul, 2008). Findings from offline tasks indicate that some linguistic features are more affected than others. However, studies have not examined heritage language knowledge across linguistic structures and have not yet examined online processing. The current study aims to further elucidate heritage language knowledge and processing across linguistic domains as revealed by event-related potentials (ERPs). ERPs were recorded while heritage speakers read Spanish sentences that included violations of lexical-semantics, syntax (word order), and morphosyntax (gender and number agreement), and indicated the sentences' acceptability. Heritage speaker data was compared to that of Spanish L2 speakers at low and advanced levels of experience/proficiency, and to L1 Spanish speakers (Bowden, Sanz, Steinhauer, & Ullman, 2007) . ERP results suggest that whereas all groups processed lexical-semantic violations similarly (N400s), processing of grammatical structures varied. Heritage speakers were similar to L1 speakers in their processing of gender and number (LAN+P600s), whereas neither group of L2 speakers was fully native-like for these structures. Heritage processing of word

order, on the other hand, was not like L1 (or Advanced L2, who showed an L1-like pattern). Furthermore, heritage speakers showed a dissociation between their ERP signatures and behavioral performance, which patterned more with L2 speakers. In sum, heritage speaker linguistic processing appears to be neither fully L1-like nor L2-like but rather displays some commonalities with both groups.

LANGUAGE: Semantic

G40

NEURAL BASIS OF GIST AND DETAIL PROCESSING: EFFECTS OF NORMAL AGING Raksha Mudar[1], Hsueh-Sheng Chiang[2], Michael Motes[2], Mandy Maguire[2], Elizabeth Bartz[2], John Hart[2]; [1]University of Illinois at Urbana-Champaign, [2]The University of Texas at Dallas — Several behavioral studies have revealed that memory for abstracted meaning, commonly referred to as gist, is relatively preserved with normal cognitive aging, in contrast to memory for details or specific content. Fewer studies, however, have investigated the effects of aging on the neural basis of gist and detail processing. This study examined processing differences in gist versus details in normal young (n=17, 20-30 years) and older adults (n=17, 65-80 years) using functional magnetic resonance imaging (fMRI). Participants judged whether a given statement corresponded to gist or details conveyed in complex static digital pictures (pretested for consistent gist and detail judgments) while fMRI data were collected. Each picture was paired with statements that conveyed congruent gist or described details that were present in the picture and foil statements that conveyed incongruent gist or described details that were not present. Findings revealed that in both groups greater activation for the gist condition was observed primarily in left superior and inferior frontal and left superior and middle temporal regions. Greater activation for details was observed in bilateral superior and inferior parietal regions in young adults. In contrast, in older adults, greater activation for details was observed primarily in right superior and inferior parietal regions. In general, older adults had greater frontal activation during both gist and detail conditions. Overlapping activation patterns in young and old during gist processing, and differential activation patterns during detail processing, might to an extent explain behavioral differences observed in memory for gist and details with aging.

G41

THE ROLE OF INFERIOR FRONTAL GYRUS IN PROCESSING CHINESE CLASSIFIERS Tai-Li Chou[1], Shu-Hui Lee[1], Shao-Min Hung[1], Hsuan-Chih Chen[2]; [1]National Taiwan University, [2]Chinese University of Hong Kong — The Chinese classifier system classifies nouns and builds a relation between the classifier and its corresponding noun. This functional magnetic resonance imaging (fMRI) study examined brain activation of Chinese classifiers during reading comprehension. Thirty-four participants read and perform semantic congruency judgments on congruous, inside-classifier violated, and outside-classifier violated sentences. The inside-classifier (IC) and outside-classifier (OC) violations were created by changing the correct classifier to an inappropriate classifier and a non-classifier, respectively. The comparison of the IC violation versus the congruent condition produced greater activation in the mid-ventral region (BA 45) of the left inferior frontal gyrus (IFG), suggesting an on-line search for coherent semantic information to perform semantic unification. Contrasting different subtypes of IC violation produced greater activation in the right IFG (BAs 45 and 47), indicating that processing mass/count classifiers involves distinct brain activations. The OC violation produced greater activation in the left IFG (BAs 45 and 44), suggesting both semantic and syntactic processing. These results indicate that different parts of the IFG contribute to syntactic and semantic processing of classifier phrases in reading Chinese for comprehension.

G42

TEST-RETEST RELIABILITY OF N400 EFFECTS IN A WORD-PAIR SEMANTIC PRIMING PARADIGM Michael Kiang[1], Iulia Patriciu[1], Carolyn Roy[1], Bruce K. Christensen[1], Robert B. Zipursky[1]; [1]McMaster University — The N400 event-related brain potential (ERP) component is a negative voltage deflection elicited by any potentially meaningful stimulus such as a word or a picture. Its amplitude is reduced (made less negative) by factors facilitating the processing of stimulus meaning - e.g., relatedness of the eliciting stimulus to a preceding one. This N400 semantic priming effect has been used as a neurophysiological probe of abnormal processing of semantic relationships in clinical disorders, and has been suggested as a possible biomarker for treatment studies. Further validation of N400 semantic priming effects as a clinical biomarker requires establishment of their test-retest reliability. We examined test-retest reliability of N400 semantic priming effects by recording ERPs in 16 healthy individuals while they viewed the same series of related and unrelated prime-target word pairs in two sessions approximately one week apart (Time 1 and Time 2). As expected, N400 amplitudes were smaller for related versus unrelated targets across both sessions. N400 semantic priming effects (amplitude differences between unrelated and related targets) were highly correlated across sessions ($r=0.85$, $p<0.0001$). However, N400 semantic priming effects were significantly smaller at Time 2 than at Time 1, due to larger N400 amplitudes for related targets at Time 2 than at Time 1. This effect of repeated testing could be due to changes in motivation. The results suggest that N400 priming effects have high test-retest reliability, but that their use as a biomarker in treatment studies should take into consideration possible decreases in magnitude with repeated testing.

G43

THE FUNCTIONAL SOURCE OF THE N400: FACILITATION OF LEXICAL ACCESS VS POST-LEXICAL INTEGRATION DIFFICULTY. A REPETITION-PRIMING ERP STUDY ON SENTENCE PROCESSING. Jakub Szewczyk[1], Herbert Schriefers[2]; [1]Jagiellonian University, Kraków, Poland, [2]Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, Netherlands — Despite the popularity of the N400 component, there are opposing theories concerning underlying processes. The main point of contention is whether N400 relies on lexical access being already done (conceptual integration difficulty), or on the ease of making lexical access. Participants were visually presented with short stories, that had a direct object noun in the story-final sentence. In half of trials the noun was semantically incongruent with the story. Congruity was fully crossed with repetition priming: all story-final sentences were preceded by presentation of 4 prime words; in the primed condition, one of the words was the direct object noun of the upcoming sentence. Participants were asked to read all sentences, memorize story-final sentences for off-line cued-recall test, and temporarily memorize the prime words, for probe-recognition test. Integration theory predicts N400 for all incongruent words, independent of priming. Pre-lexical theories assume N400s index word's preactivation level and predict no N400 for primed incongruent words. Unprimed incongruent words led to a standard N400. Primed incongruent words led to identical N400 for subjects with low cue-recall scores (which we interpret as inhibition of context-incongruent primes during processing of story-final sentences); good memorizers had N400s largely reduced (episodic trace protects against inhibition). For congruent words, priming led to reduction of N400, resulting from priming-induced preactivation. Two control experiments show that none of these are effects of expectation or probe words recognition. These experiments support theories assuming that the N400 results from processes leading to lexical access and refine our understanding of attention-memory-language interactions.

G44

(DIS)ASSOCIATIONS BETWEEN SPEECH AND GESTURE IN NAMING SPATIAL RELATIONS Tilbe Goksun[1], Matt Lehet[1], Katie Malykhina[1], Anjan Chatterjee[1]; [1]The University of Pennsylvania — Speech and gesture are complementary components of an integrated language system (McNeill, 1992). How impaired verbalization of spatial relations relates to gesture production is not known (Kemmerer et al., 2007). The goal of this study is to determine if language and gesture deficits co-occur in focal brain injured patients' descriptions of spatial relations or if gestures can compensate for language deficits. Patients with left (LHD, n=13) or right hemisphere damage (RHD, n=11), and elderly controls (n=8) were asked to name static (e.g., an apple IN a bowl – 24 trials) and dynamic (e.g., a pen MOVES OVER a box – 28 trials) spatial relations depicted in brief video clips. The correct use of prepositions in each task and gestures that represent the spatial relations (e.g., moving the hand in an arc to represent MOVE OVER) were coded. Not surprisingly, patients with LHD made more errors in naming both static and dynamic prepositions compared to RHD and controls, ps<.035 (errors in static: MLHD=5.3, MRHD=0.8, Mcontrols=0.8 and errors in dynamic: MLHD=5.8, MRHD=1.8, Mcontrols=0.1). While naming static relations, LHD patients produced more spatial gestures than RHD and controls, p=.004 (MLHD=5, MRHD=1.09, Mcontrols=0.75). No difference was found in dynamic gesture production between LHD and RHD patients (MLHD=8.7 and MRHD=8). Accuracy in naming negatively correlated with gesture rates, r=-.44, p=.003. In some cases, patients represented the correct spatial information only in gesture. These findings suggest that although speech and gesture are closely linked, gesture production may compensate for impaired lexical access to prepositions.

G45

SEMANTIC COMPETITION IN TBI PATIENTS Lian Chu[1], Fanpei Yang[1], Tracy Luks[2], Sara LaHue[2], Pratik Mukherjee[2]; [1]National Tsing Hua University, Hsinchu, Taiwan, [2]University of California San Francisco — Research has reported that patients with mild traumatic brain injury (TBI) suffer from impaired verbal memory using measures of neuropsychological testing. Verbal memory deficits might arise from failure in semantic control. The present study aims to study the semantic network in TBI patients in semantic competition. Seven controls (6 males and 1 females, mean age=31) and fourteen patients (9 males and 5 females, mean age=31) participated in the study. Subjects were asked to decide whether words in a pair were related, indicating their decision by pressing the buttons. Each trial contained the first pair as a probe, the second pair as a target, and a focal point. We had three conditions: consistent, inconsistent, and control. All image processing was performed using SPM5, P<0.005. Two sample T-test revealed that controls have more activations in metaphors than patients whereas no voxels survived for the patient>control comparison. The control>patient comparison of inconsistent metaphors and consistent metaphors (metaphoric competition) revealed significantly greater involvement in the cingulate and the left middle frontal gyri. Controls activated the right precentral gyrus for homonymic competition (inconsistent homonym>consistent homonym) and the cingulate gyrus for metaphoric competition. In contrast, patients did not have any voxels survived for either contrasts. Our results suggested that controls involved more self-monitoring and working memory regions to resolve semantic competition. Overall hypo-activations in multiple regions in patients suggested disrupted connectivity in semantic networks. Lastly the metaphoric property is more likely to reveal subtle deficits in semantic memory networks in TBI patients.

G46

THE INFLUENCE OF SEMANTIC PROPERTY AND GRAMMATICAL CLASS ON MANDARIN SEMANTIC COMPETITION Fanpei Yang[1], Dai-Lin Wu[1], Cheng-Te Wang[1]; [1]National Tsing Hua University, Hsinchu, Taiwan — Although research suggested representational differences between metaphoric and polysemous words, imaging studies have not successfully demonstrated consistent neural distinctions. We conducted a semantic relatedness judgment task using event-related fMRI. Nine native speakers of Mandarin (7 females, 2 males) were asked to decide whether words in a pair were related, indicating their decision by pressing buttons. Each trial contained the first pair as the probe, the second pair as the target, and a focal point. We had three conditions: consistent, inconsistent and control. Consistent and inconsistent trials contain the same ambiguous words (e.g., metaphor or polysemy) in the 2nd position. Words in the first position were either nouns or verbs. In the consistent condition, the first and the second word pair refer to the same meaning of the ambiguous word. In the inconsistent condition, the second pair refers to a different sense of the polysemy or metaphor. The control condition contained subsequent pairs of words that do not share a common meaning. Imaging results indicated that the inconsistent vs consistent metaphors activated the inferior parietal lobule regardless of the grammar classes. The noun-noun inconsistent>consistent metaphors involved the right middle frontal and middle temporal gyri, whereas the noun-verb pairs activated the orbitofrontal gyrus. The noun-noun inconsistent>consistent polysemy activated the superior, middle and inferior temporal gyri, while the noun-verb pairs did not have any survived voxels. These findings support our hypothesis that words with different semantic properties are manifested at the neural level and that different grammatical classes influence ambiguity resolution.

G47

THE USE OF IMPLICIT MEASURES TO ASSESS RECEPTIVE VOCABULARY KNOWLEDGE IN NORMAL ADULTS AND NORMALLY DEVELOPING CHILDREN. Ishanti Gangopadhyay[1], Kerry Ledoux[1], Laura Bosley[1], Barry Gordon[1,2]; [1]The Johns Hopkins University School of Medicine, [2]The Johns Hopkins University — Introduction: An important question about assessing language comprehension is whether we can use implicit measures to detect evidence of receptive vocabulary knowledge in the absence of explicit behavioral responses. In this study we use eye movements (EMs), pupillary dilation (PD), and event-related potentials (ERPs) as measures of receptive vocabulary knowledge in two groups – normal adults and normally developing children. Methods: 20 normal adults (ages 18 and over) and 20 normally developing children (ages 5-17) were tested. Participants completed a) a forced choice recognition task (EM and PD), where four pictures were presented on a computer screen, along with an auditory token that named one of the pictured objects; and b) a congruity task (ERP), where single pictures were shown on the computer screen, accompanied by an auditory token that did or did not match the name of the pictured item. Results: Adults and children showed similar patterns of results for all three measures. EMs were faster for pictures that matched the auditory word, but only for known words. End-of-trial fixations were on the named picture more frequently for known words. Mean PDs were greater for unknown words than for known words. Additionally, an N400 congruency effect was observed for known words, but not for unknown words. Conclusion: The three measures (EM, PD, ERP) differentiated known from unknown words in both participant groups. Importantly, these measures could prove to be useful and valid measures of receptive vocabulary knowledge in the absence of overt responses.

G48

EVENT-RELATED BRAIN POTENTIALS OF SEMANTIC ACCESS AND MEMORY FOR EMOTIONAL LANGUAGE Daniel J Frost[1,2], Kara D Federmeier[1]; [1]University of Illinois at Urbana-Champaign, [2]University of California San Diego — Emotional language differs from non-emotional language in calling to mind positive or negative attributions (valence) of varying intensities (arousal). Understanding the power of emotional language to shape behavior requires distinguishing the independent contributions of valence and arousal to brain activity associated with processing words for meaning. The current study examines effects of valence on semantic access and memory for low arousal words. Electroencephalograms were recorded from 20 (10 female; age=18-21, mean=19) University of Illinois students as they assessed the applicability of posi-

tive, negative, and neutral words to "UofI students" generally or themselves specifically. Each word was repeated to examine effects of valence on semantic access and on-line memory. Studies have shown that differences in ERPs across repeated presentations reflect facilitated semantic access and memory activation, as indexed by the N400 and Late Positive Complex. Our results show that on first presentation there were no differences due to valence on the N400 or LPC. On second presentation, all conditions showed increased positivity on the N400 and LPC (i.e., ERP repetition effect). Critically, the repetition effect was not sensitive to valence. However, post-hoc analysis revealed that neutral words elicited a greater frontally-distributed negativity 300–700 ms post-stimulus onset compared to valenced words, possibly reflecting greater difficulty in assessing the applicability of neutral words. This frontal difference was eliminated by repetition. These results suggest that valenced words are semantically processed and remembered similarly to neutral words, and previously reported ERP effects of emotion are likely the result of arousal rather than valence differences.

G49

FRONTAL AND TEMPORAL-LOBE ACTIVATION IN WORD RETRIEVAL IN PATIENTS WITH TEMPORAL-LOBE EPILEPSY Alexander Barnett[1], Mary Pat McAndrews[1]; [1]University of Toronto — Functional MRI is rapidly becoming a standard clinical tool for identifying language-relevant brain regions in patients with temporal-lobe epilepsy (TLE) who are being investigated for surgery for relief of seizures. Activation protocols vary in the extent to which they are differentially sensitive to anterior versus posterior language regions and in the extent to which they demonstrate strong lateralization effects between hemispheres. In this study, we examined differences in the magnitude of activation in both frontal and temporal lobes of the dominant hemisphere in patients with TLE as a function of the activation task. Here, two tasks required word generation according to cues that provided a great deal of semantic support/constraint (naming to description and sentence completion; NS) and two that provided relatively little support/constraint (verb generation and category fluency; VC) . We expected there to be greater engagement of frontal regions in the latter, as there is more opportunity for response competition and less semantic richness in the cues. We scanned patients during each of these tasks and compared activation in predefined frontal and temporal regions (based on anatomic masks) for task versus fixation baseline. For patients with both left and right TLE, we found that the VC tasks showed greater involvement of frontal relative to temporal regions whereas the NS tasks showed equivalent activation in both regions. These findings are consistent with theories that suggest frontal regions may be more important in executive processes supporting semantic retrieval than semantic access per se.

LONG-TERM MEMORY: Episodic

G50

DIFFERENT ROUTES OF SEMANTIC ACCESS MODULATE THE INTERPLAY BETWEEN EPISODIC AND SEMANTIC MEMORIES. Bethany Coad[1,2], Edward Wilding[1,2], David Donaldson[3], Andrea Greve[4]; [1]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, [2]Wales Institute of Cognitive Neuroscience (WICN), [3]Psychology, School of Natural Sciences, University of Stirling, [4]Medical Research Council (MRC) Cognition and Brain Sciences Unit, Cambridge; — Episodic and semantic memories interact dynamically, but how this occurs is largely unknown. Certain kinds of semantic encoding operations result primarily in changes to familiarity-based episodic memory judgments. Others, meanwhile, result primarily in changes to recollection-based judgments. These findings can potentially be reconciled by assuming that stimulus-driven and strategy-driven semantic manipulations evoke different kinds of interactions with episodic retrieval. The former impact primarily on the process of familiarity, while the latter impact on the process of recollection. We investigated this possibility in two experiments. In both, event-related potentials (ERPs) were acquired during the test phases of recognition memory tasks. In the first experiment, participants completed a lexical decision task at study. Memory was superior for words than for non-words, and an ERP index of familiarity was larger for words, consistent with the view that (i) stimulus-driven access influences familiarity, and (ii) this process is responsible for the differences in response accuracy. In the second experiment, words were subjected to either semantic or non-semantic encoding. Memory at test was superior following semantic rather than non-semantic encoding. ERP indices of familiarity at test were invariant across encoding tasks, and an ERP index of recollection was larger following deep encoding. Overall, the correspondences between the behavioural and ERP findings indicate that the route by which semantic information is accessed plays a critical role in guiding the type of interplay between episodic and semantic memories.

G51

NEURAL ACTIVITY RELATED TO SELF-INITIATING ELABORATIVE SEMANTIC ENCODING DURING NON- SEMANTIC ENCODING TRIALS Colin Hawco[1], Jorge L. Armony[1], Martin Lepage[1]; [1]Douglas Hospital Research Center, McGill University, Montreal, Canada — Numerous groups, including patients with psychosis, Alzheimer's Disease, or frontal lobe lesions, as well as healthy aging individuals, show a decrease in the self-initiation of efficient memory encoding strategies, resulting in reductions in memory performance. In order to better understand the brain regions involved in elaborative encoding strategies, we performed an fMRI study in which we controlled for the use of different encoding strategies. Twenty-three healthy young participants were presented triads of objects in which either neither, one or both objects in the bottom of the triad were related to the top object. Participants were given two encoding instructions that required them to indicate the number of semantic ('related?') or physical ('smaller?') relationships in the triad. We found increased reaction time as a function of the number of semantic relationships in the triad for both encoding conditions, indicating that semantic analysis was still performed for the non-semantic encoding task. We performed a masking conjunction analysis on the fMRI data to find areas with greater activity for the non-semantic >semantic encoding tasks that were modulated by increasing semantic relationships during non-semantic encoding. We found activity in the left dorsolateral prefrontal cortex (DLPFC) and bilaterally in the supramarginal gyrus. We suggest that the DLPFC is the most likely candidate region for the self-initiation of elaborative semantic encoding during non-semantic trials, while the supramarginal activity is likely related to attentional effects. This could have important implications for understanding neurological changes in patients who show a deficit in self-initiated memory strategy use.

G52

NEURAL CORRELATES OF EPISODIC COUNTERFACTUAL THINKING Felipe De Brigard[1,2], Donna Rose Addis[3], Jaclyn Ford[1], Daniel Schacter[2], Kelly Giovanello[1]; [1]UNC, Chapel Hill, [2]Harvard University, [3]The University of Auckland — Recent evidence suggests that remembering the past and imagining what might happen in the future largely depend on the same core brain network, including medial temporal lobe, posterior cingulate, medial prefrontal and lateral temporal/parietal cortices. However, the extent to which this network is also responsible for our capacity to think about what could have happened in our past, yet did not occur (i.e., episodic counterfactual thinking), is still unknown. To examine this issue, participants were asked to generate 100 specific autobiographical memories during a pre-scan interview. Ten days later, participants performed 4 tasks while undergoing fMRI: (1) remember an event, (2) imagine a better outcome for an event, (3) imagine a worse outcome for an event, and (4) imagine another way to get the same outcome. Partial least squares (PLS) analysis identified a pattern of brain activity across the core network common to episodic memory and episodic counterfactual thinking. PLS also identified two different patterns of brain activity for likely and unlikely episodic counterfactual thoughts, with the former showing significant overlap with the regions engaged during episodic recollection. To explore the differential engagement of brain regions during

likely versus unlikely counterfactual thoughts, a parametric modulation revealed that activation of areas such as the middle frontal gyrus, the parahippocampal gyrus, and the hippocampus was modulated by the subjective likelihood of counterfactual simulations. These results suggest that episodic counterfactual thinking engages the core network, and that the subjective likelihood of our counterfactual thoughts modulates the engagement of different regions within this network.

G53

DISSOCIATION OF RECOLLECTION-RELATED NEURAL ACTIVITY IN VENTRAL LATERAL PARIETAL CORTEX Sarah Yu[1], Jeffrey Johnson[2], Michael Rugg[1]; [1]Center for Vital Longevity and School of Behavioral and Brain Sciences, University of Texas at Dallas, [2]Department of Psychological Sciences, University of Missouri — fMRI studies of recognition memory have reported enhanced activity in two regions of ventral lateral parietal cortex—the angular gyrus and temporo-parietal junction (TPJ)— when recognition is accompanied by recollection. According to one proposal, ventral parietal recollection effects reflect processes involved in maintaining or representing recollected information. Another proposal suggests the effects reflect attentional re-orienting to the products of recollection. The present experiment addressed the question whether these operations map on to the angular gyrus and TPJ, respectively. Subjects (N=16) were scanned during a recognition memory test that combined the 'Remember/Know' and source memory procedures, and that allowed test items to be segregated both according to whether they elicited a subjective sense of recollection, and additionally by the quality of the contextual information that could be retrieved (indexed by the confidence of the source memory judgment). Activity in angular gyrus tracked amount of recollected information, whereas activity in TPJ was enhanced for items endorsed as recollected, but was insensitive to the amount of information recollected. These findings are consistent with much prior evidence that the angular gyrus and TPJ are functionally heterogenous, and suggest that the role of the ventral parietal cortex in episodic memory cannot be accounted for in terms of a single cognitive construct.

G54

NEURAL EVIDENCE THAT RECOLLECTION AND FAMILIARITY MAKE INDEPENDENT CONTRIBUTIONS TO RECOGNITION MEMORY JUDGMENTS Lisa Evans[1], Edward Wilding[1]; [1]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University — In the Remember/Know task people give Remember, Know or New responses to studied and unstudied stimuli. The task is assumed to depend on the two processes of recollection and familiarity, but how they contribute is contentious. Recollection involves recovery of encoded contextual information. Familiarity is a scalar memory strength signal. By one view, recollection supports Remember responses, familiarity Know responses and the two are independent. By another view, Remember responses are typically associated with high levels of recollection and familiarity, Know responses with lower levels of both. We attempted to separate these accounts using event-related field (ERF) measures of neural activity, as ERFs index recollection and familiarity. ERF signal changes linked to recollection were greater for Remember than Know responses. Signal changes linked to familiarity, however, were greater for Know than for Remember responses. This second outcome challenges accounts where both processes contribute to Remember and Know judgments, according to which signal changes for recollection and familiarity will be greater for Remember than for Know judgments. The outcome is entirely consistent, however, with an account where recollection and familiarity are independent processes, wherein the larger signal change for familiarity arises because the level of familiarity associated with all Know responses will be above a criterion, whereas, under independence, the is no comparable lower bound for the level of familiarity associated with Remember responses. The findings in this ERF study thus argue strongly for models where the relationship between recollection and familiarity is one of independence.

G55

DO UNINFORMATIVE CUES ELICIT PRESTIMULUS SUBSEQUENT MEMORY EFFECTS? Marianne de Chastelaine[1], Michael D. Rugg[1]; [1]Center for Vital Longevity and School of Behavioral and Brain Sciences, The University of Texas at Dallas — Previous research has demonstrated that medial temporal lobe (MTL) activity during the interval between a warning cue and a study item can predict whether or not the item will be remembered on a later memory test. Studies reporting MTL prestimulus subsequent memory effects have employed designs in which prestimulus cues signaled the nature of the task to be performed on the upcoming study item, or the item's presentation modality. Here we used fMRI to investigate whether prestimulus effects are evident when the prestimulus cue is uninformative. Eighteen young participants were scanned while a series of study words were visually presented. Each word was presented on either an orange or a blue background, the color denoting whether the word should be subjected to an animacy or a syllabic judgment. A generic warning cue was presented prior to each word. To allow cue- and item-related activity to be deconvolved, the cue-item interval varied randomly between 1s, 3s and 5s. Following the study phase, a surprise recognition memory test was administered in which each test item required a 'Remembered', 'Known' or 'New' endorsement. Prestimulus subsequent memory effects were localized largely to occipital cortex. By contrast, stimulus-related effects were evident in bilateral parahippocampal cortex. These findings suggest that, while prestimulus subsequent memory effects can be elicited with uninformative cues, effects in the MTL depend upon the availability of information about the study task.

G56

FUNCTIONAL CONNECTIVITY AND SUBSEQUENT MEMORY: INCREASED NEURAL CO-ACTIVATION DURING POST-TASK RESTING STATES IS RELATED TO LATER MEMORY PERFORMANCE Brian Roberts[1], Garth Thompson[2], Jaemin Shin[3], Hillary Schwarb[4], Shella Keilholz[5], Eric Schumacher[6]; [1]Georgia Institute of Technology, [2]Emory University, [3]Air Force Research Lab — Abstract Recent fMRI experiments show a relationship between performance on paired associate learning tasks and patterns of temporal synchronization between task activated brain regions during rest (Tambini et al., 2010). Previous work has shown that activity in fusiform gyrus, medial temporal lobe (MTL), and the left inferior frontal gyrus (LIFG) during encoding predicts later recall. The current study sought to unify and test these findings within one experiment. We hypothesized that the formation of stable memory traces is subserved by a memory consolidation network composed of frontal and temporal lobe regions, and that long term storage of encoded stimuli relies in part on the degree of co-activation observed between brain regions within the network. Results support this hypothesis by showing that subsequent memory was predicted by activity at encoding in fusiform, LIFG, and MTL regions and by the increased connectivity between these regions during post-task resting states.

G57

NEURAL ACTIVITY SUPPORTING ENCODING OF ITEM-CONTEXT ASSOCIATIONS Heekyeong Park[1], Fernando Leal[1], Catherine Spann[1]; [1]University of Texas at Arlington — Previous fMRI studies have suggested that successful memory formation of an item elicits neural encoding activity specific to study task or study material. Further research has shown that successful formation of item-context associations in memory recruits neural activity in the medial temporal lobe including the hippocampus during encoding. The present study investigated whether the regions engaged during successful encoding of item-context associations varied depending on study material while study task was kept consistent. Participants were scanned while they performed a semantic judgment task on a list of words and pictures presented in one of four colored backgrounds. In a subsequent test phase, participants were given item-context recognition on studied and new items. Participants were asked to indicate whether the test item was studied, and, if it was studied, which color the item was presented at study. In accordance with previ-

ous findings, the studied items that were correctly endorsed with the studied background color elicited greater activity in both the medial temporal lobe and inferior frontal lobe as well as activity in extensive occipital areas. For studied words that were later correctly judged with its source, enhanced activity was found in left mid frontal and right inferior temporal regions during encoding. Successful formation of pictures was also associated with activity in left mid frontal regions. The findings suggest that encoding of item-context associations with words and pictures recruits neural activity in common brain regions.

G58

THE SENSITIVITY OF THE LEFT PARIETAL OLD/NEW ERP EFFECT TO THE SALIENCE OF RECOLLECTED INFORMATION

Rachael Elward[1], Michael D. Rugg[1]; [1]Center for Vital Longevity and the School of Behavioral and Brain Sciences, The University of Texas at Dallas — The left parietal 'old/new' ERP effect is a neural correlate of recollection. It has been linked to the fMRI recollection effects consistently reported in inferior parietal cortex. According to one proposal, these effects reflect the role of this region in supporting the representation of recollected information. The effects have also been argued to reflect the re-orienting of attention to salient events, such as the occurrence of recollection. We attempted to adjudicate between these proposals by manipulating the salience of recollected information. According to the representational account, salience should not impact the left parietal effect, whereas the attentional account predicts that the effect should vary with salience. Subjects (n=16) studied a series of pictures, each paired with one of two coins, a Deutschmark or a Lira. At test, the requirement was to discriminate between studied pictures paired with the Deutschmark or the Lira, with a separate response for new pictures. There was a reward of $2.00 for correctly detecting pictures paired with the Deutschmark, but only a 2 cent reward for identifying pictures studied with the Lira. ERPs for recollected test items demonstrated robust left parietal old/new effects that did not differ according to level of reward. Importantly, an earlier, more anteriorly distributed, effect did differ reliably according to reward value, indicating that the null finding for the left parietal effect is not due to a generic insensitivity to reward value. These findings favor the representational account of the left parietal old/new effect.

G59

NEURAL CORRELATES OF ITEM AND CONTEXT RETRIEVAL IN THE MEDIAL TEMPORAL LOBES

Wei-chun Wang[1], Andrew P Yonelinas[1], Charan Ranganath[1]; [1]University of California, Davis — The 'binding of item and context' (BIC) model (Diana, Yonelinas, Ranganath, 2007; Eichenbaum, Yonelinas, Ranganath, 2007) predicts that the perirhinal cortex supports processing of item information, the parahippocampal cortex supports the processing of context information, and the hippocampus binds item and context information together to form episodic memories. In most studies, however, item and context are operationalized as different types of memoranda (e.g., memory for words vs. encoding tasks). Here, we tested the extent to which different medial temporal lobe regions would be involved in retrieval of item or context information even when the stimulus materials were held constant. To test these ideas, we developed a unique memory paradigm in which participants encoded pairs of fractal images in which one fractal was treated as an item and the other was treated as a context. At test, participants were cued with studied 'items' and 'contexts' and asked to retrieve the corresponding associated fractals while being scanned. Results indicated that the hippocampus and parahippocampal cortex were involved when recalling fractals that were encoded as items or as contexts. In contrast, the perirhinal cortex was involved when recalling fractals that had been encoded as items, but it was not involved when recalling fractals that were encoded as contexts. The results offer support of differential contributions to long term memory for items and contexts in the medial temporal lobes.

G60

COMPARING THE NEURAL CORRELATES OF THE PRIMACY EFFECT AND THE VON RESTORFF EFFECT IN FREE RECALL – AN ERP STUDY

Siri-Maria Kamp[1], Glen R. Forester[1], Anthony R. Murphy[1], Emanuel Donchin[1]; [1]University of South Florida — Free recall is enhanced for the first few study stimuli ("Primacy effect"), and for stimuli isolated from the list by physical properties ("Von Restorff effect"). It has been established (Karis et al, 1984) that there is a correlation between the amplitude of the P300 elicited by the "isolates" and the likelihood that an isolate will be recalled. In the present study we assessed the degree to which this "subsequent memory effect" is observed for stimuli in the first study list positions, thus explaining the Primacy effect. Using maintenance rehearsal, participants studied and immediately recalled word lists including one physically deviant "isolate". The first words in a list and isolates were better recalled and elicited a P300, whose amplitude was correlated with subsequent recall. Additionally, a frontal slow wave gradually increased in amplitude for positions 1, 2, and 3. This component showed a subsequent memory effect only for the first two serial positions and for isolates. Finally, a posterior slow wave was correlated with recall for all words in middle list positions, but not for primacy positions. These findings indicate that (1) both the Von Restorff effect and the Primacy effect may in part be explained by the outcomes of a context updating process indexed by the P300, which facilitates later retrieval, (2) cognitive processes associated with a frontal slow wave, possibly indexing working memory load, also contribute to both behavioral effects, and (3) a posterior slow wave subsequent memory effect is uniquely associated with words in middle serial positions.

G61

HIPPOCAMPAL ACTIVITY DURING ENCODING PREDICTS GRADED LEVELS OF REACTIVATION DURING SUBSEQUENT ASSOCIATIVE RETRIEVAL

Jared Danker[1], Lila Davachi[1]; [1]New York University — Successful recovery of episodic detail is thought to be mediated by the reactivation of sensory brain regions during retrieval. Furthermore, it is presumed that reactivation should be related to the strength of the initial encoding event. To test this, we explored the relationship between trial-by-trial activity in the hippocampus during encoding and trial-by-trial reactivation of modality-specific encoding regions during subsequent retrieval. Specifically, we predicted that those trials that elicit strong hippocampal activation during encoding (associated with strong binding) would also elicit strong reactivation during subsequent retrieval (associated with vivid remembering). During a scanned encoding session, participants associated 80 nouns with corresponding sounds and 80 nouns with corresponding pictures. One day later, during a scanned retrieval session, participants were presented with the 160 nouns and were instructed to indicate whether each noun was studied with a sound or with a picture. Trial-by-trial beta estimates were extracted from the hippocampus during encoding and these estimates were then used as a regressor on the retrieval data to detect regions whose retrieval activity is predicted by encoding activity on a trial-by-trial basis. Consistent with our prediction, we found that hippocampal activity during the encoding of subsequently remembered pictures was associated with the reactivation of a number of picture-selective regions during subsequent successful picture retrieval. Corresponding across-subject correlations will also be reported. Our findings suggest that the strength of associative binding, as indicated by hippocampal activity during encoding, is directly related to more vivid remembering of source details, as indicated by reactivation during retrieval.

G62

REWARD-ENHANCED DISCRIMINATION IN A VISUAL OBJECT PATTERN SEPARATION TASK

Samuel Ji[1], Alisha Jamil[1], Daniel Spira[1], Michael Yassa[1]; [1]Johns Hopkins University — The release of dopamine associated with reward feedback is thought to enhance hippocampus-dependent memory formation. There is accumulating evidence strongly suggesting that the hippocampus's ability to rapidly encode unique experiences is

mediated by pattern separation (Yassa and Stark, TINS 2011). This study examines the role of reward in enhancing pattern separation of similar items. Forty-eight participants completed a visual object pattern separation task broken into two separate sessions. During the first session, participants were asked to categorize objects as being outdoor or indoor objects. On a random subset of trials, they received a small monetary reward (non-contingent on their responses). In the second session, subjects completed a recognition memory test in which they classified pictures as "old", "similar", or "new" based on the objects seen in the first session. We found that when presented with a lure that had been rewarded in the first session, participants were significantly less likely to false alarm (call them "old") than if the lure had not been rewarded. However, performance on exact repetitions was no different for rewarded and unrewarded items. These data indicate that reward may directly mediate pattern separation abilities, perhaps by enhancing the post-encoding processes that may be involved in creating a detailed and unique representation for the experience.

G63

SEPARATING RECOLLECTION AND FAMILIARITY: REMEMBER-KNOW AND SOURCE MEMORY TESTS Amy Frithsen[1], Michael B. Miller[1]; [1]University of California, Santa Barbara — Retrieval during recognition memory is thought to be comprised of a mixture of recollection and familiarity processes. Separating these two types of retrieval, both at the behavioral and neural level, is a difficult and challenging task. Two common methods for doing so are the remember-know paradigm and tasks involving source memory attributions. Neither of these methods is ideal, as each is accompanied by unique and valid criticisms. The current study is one of very few to directly compare and contrast these methods as a within-subjects manipulation. Thirty subjects studied a total of 304 words and were scanned while performing a remember-know test and a source memory test. Recollection and familiarity responses, as well as brain regions associated with those responses, were identified according to standard remember-know and source memory procedures. Behavioral and neural results were then compared at both an individual and a group level. Behaviorally, the two methods gave slightly different estimates of recollection and familiarity, with the remember-know test resulting in higher levels of recollection and the source memory test with higher levels of familiarity. At the neural level, several prefrontal, parietal, and temporal regions were activated during recollection (as identified by each test), however little to no brain regions were uniquely activated by familiarity (again, as defined by each test). Results of this comparison speak to the validity of the remember-know and source memory tests in accurately separating recollection from familiarity.

G64

MAINTAINING RETRIEVED EPISODIC INFORMATION: AN FMRI STUDY Kaia L. Vilberg[1], Michael D. Rugg[1]; [1]Center for Vital Longevity and School of Behavioral and Brain Sciences, University of Texas at Dallas — Whereas numerous studies have investigated the neural correlates of successful episodic retrieval, little attention has been given to the neural networks supporting the controlled maintenance of successfully recollected information. In the present experiment, subjects studied a series of word-image pairs under the requirement to judge which of the paired objects was smaller. Following each of 4 study sessions, a scanned test phase occurred in which a series of studied and unstudied words was presented. The requirement at test was to decide whether each word was old or new and, if judged old, to retrieve the associated study picture and hold it in mind until a test cue appeared. The item-cue interval varied between two and eight seconds. The cue instructed subjects which of three different judgments should be applied to the retrieved picture (bigger than a shoebox? household object? living?). Separate responses were required when words were either deemed new or the associated image could not be retrieved. fMRI data were modeled to separately estimate activity elicited by the test items as opposed to activity sustained over the item-cue interval ('delay activity'). Relative to trials where the cued picture could not be retrieved, item-elicited activity for trials associated with a correct picture attribute judgment was enhanced in the left medial temporal lobe, among other regions. Delay activity was evident in medial and lateral prefrontal cortex, and inferior temporal cortex. Thus, as in the case of the maintenance of incoming perceptual information, maintenance of recollected information engages a frontal-posterior cortical network.

G65

ENHANCED HIPPOCAMPAL MEMORY IS ASSOCIATED WITH GREATER AEROBIC CAPACITY IN HEALTHY YOUNG ADULTS Andrew Whiteman[1], Daniel Young[1], Ethan Pravetz[1], Robert Wagenaar[1], Chantal Stern[1], Karin Schon[1]; [1]Boston University — Animal studies suggest aerobic exercise augments memory by upregulating the expression of growth factors that mediate several forms of plasticity in the hippocampus and surrounding cortices. Among these growth factors, the neurotrophin, brain derived neurotrophic factor (BDNF), specifically facilitates neuronal growth, differentiation, and long term potentiation. Our goal was to examine the link between exercise, aerobic capacity, and hippocampal memory in humans. To investigate this in healthy young adults, we used a VO2max test of aerobic capacity in combination with two memory tasks shown in fMRI studies to recruit the hippocampus. The first task tested subsequent memory (SMT) for images encountered in a working memory paradigm (Schon et al., 2004), and the second task assessed relational learning (Kirwan and Stark, 2004). Prior to cognitive testing, we collected peripheral blood samples to assay serum BDNF. Preliminary results (n = 12) show several strong correlations between VO2max and high confidence, correct judgments in the SMT, and decreased misclassifications in the relational task. Our results provide supporting evidence for a link between exercise, aerobic capacity and hippocampal memory. These findings extend the animal work to humans, and may have important, practical implications for attenuating memory decline due to aging and to age related dementia.

G66

MAKING THE FUTURE MEMORABLE: THE PHENOMENOLOGY OF REMEMBERED EPISODIC SIMULATIONS Victoria Martin[1], Daniel L. Schacter[2], Michael C. Corballis[1], Donna Rose Addis[1]; [1]The University of Auckland, [2]Harvard University — We recently showed that the hippocampus is important for encoding imagined future simulations into memory. Here we investigated whether memory for an imagined event can be predicted by phenomenological ratings of the simulation and its components. In session one, 13 participants each generated 110 past episodic events, identifying a relevant person, place, and object detail ('memory components') in each. They also rated recollection for each memory component. One week later, in session two, participants imagined 90 future events involving randomly rearranged sets of memory components, and rated the detail and plausibility of each simulation. An unexpected cued-recall test then probed their memory for the event components. We used a log-likelihood multilevel random coefficient model to assess whether the quality of the memory components (recollection ratings of people, places, and objects) or the simulation itself (event detail, event plausibility) influenced the likelihood of the simulation being successfully encoded and recalled. The recollective quality of the memory components did not directly influence level of recall, whereas highly plausible and highly detailed simulations were more likely to be recalled. However, recollection ratings did influence the level of detail comprising simulations, such that simulations involving highly recollective people, places, and objects tended to be rated as more detailed. Recollection ratings of memory components therefore have an indirect effect on encoding, via their influence on event detail. Consequently, when testing subsequent memory for imagined events, it is important to consider the recollective quality of memory components, as well as ratings of event detail and plausibility.

G67

EXAMINING THE EFFECTS OF PLAUSIBILITY ON THE CONSTRUCTION OF FUTURE EVENTS Valerie van Mulukom[1], Reece P. Roberts[1], Donna Rose Addis[1]; [1]The University of Auckland — We have previously found that contextual novelty affects the process of simulating future events. Using a repetition-suppression paradigm in the fMRI scanner, we observed that when participants imagined a future event three times, reaction times (RT) and activity in medial temporal regions decreased with reduced contextual novelty. It is possible that categorical novelty – the unusualness or implausibility of these imagined scenarios within the context of one's life – might also influence repetition-suppression effects as well as the vividness of the imagined events. In this study, participants retrieved 50 memories, and identified a person, place and object in each. These memory details were randomly recombined and 40 sets were later presented as simulation cues. Future events involving the presented details were imagined three times, and rated for categorical novelty (plausibility) and vividness (level of detail). Imagined events were divided into post-hoc plausibility conditions (high, low) according to participant ratings. Preliminary analyses on data from 10 participants reveal there is a significantly greater RT suppression effect for implausible relative to plausible events. Moreover, there was a trend for RT during the first simulation to be higher for implausible than plausible events, but there was no difference by the third simulation. Plausible events tended to be more detailed than implausible events; again, this difference was most apparent during the first simulation. These preliminary findings suggest that there are important differences in the initial construction of future events depending on categorical novelty or plausibility, but that these differences may diminish with repeated simulation.

G68

FRAME OF MIND: FOCUSING STUDENTS ON PERFORMANCE OR MASTERY YIELDS A DOUBLE DISASSOCIATION OF THE NEURAL PROCESSES PREDICTING SUBSEQUENT MEMORY. Belen Guerra-Carrillo[1], Sylvia Rodriguez[2], Jennifer Mangels[1]; [1]Baruch College, City University of New York, [2]Columbia University — Two achievement goals have been identified to influence students' educational outcomes: performance and mastery. A performance orientation stresses the importance of proving one's abilities to achieve in comparison to others. Traditionally, this goal has been associated with poorer academic outcomes and processing information at a superficial level. Conversely, a mastery goal emphasizes seeking out learning opportunities, investing effort in learning, and has been linked to positive academic outcomes. Past research has primarily examined these relationships using individual difference measures. The current study extends this work by investigating how framing a challenging general knowledge task as either an opportunity to demonstrate ability compared to others (performance framing) or as an opportunity to learn new things (mastery framing) influences students' ability to use feedback to correct memory errors on an immediate retest. Although we found no behavioral difference in error correction, event-related potentials (ERPs) recorded to performance (accuracy) and learning (correct answer) feedback after each trial revealed different ventral stream mechanisms by which people learned. From 200-800ms post-learning feedback, performance framing was exclusively associated with subsequent memory effects over parieto-occipital sites, whereas mastery framing was associated with effects exclusively over inferior fronto-temporal sites. The spatiotemporal distribution of the ERPs in the mastery framing is characteristic of deep semantic processing, whereas the distribution for the performance framing is typical of a shallow, more perceptual level of encoding. This double disassociation suggests that subtle changes in the framing of a task can influence the processes a person uses to encode information.

G69

THE INFLUENCE OF POST-ENCODING STRESS ON EMOTIONAL MEMORY TRADE-OFFS Jessica Payne[1], Elizabeth Kensinger[2], Stephen Mattingly[1]; [1]University of Notre Dame, Department of Psychology, [2]Boston College, Department of Psychology — Due to restrictions on how much an organism can encode, process, and remember, the brain must pick and choose which information to preserve in memory. This selection process is influenced both by the valence and arousing nature of the information presented, as well as the state of the brain. Across numerous experiments, we have shown an emotional memory "trade-off effect", where memory for negative arousing objects (but not neutral objects) is selectively preserved at the cost of memory for the neutral backgrounds on which they appear. However, it is not yet known how stress exposure and cortisol elevation during the consolidation process affect such trade-offs. Because previous studies demonstrated that stress exposure benefits negative information while impairing neutral information, we predicted that stress exposure following encoding would produce a larger benefit for negative objects but a larger detriment to the neutral backgrounds on which they appear. Although a significant three way interaction was found between image component, valence, and condition $F=4.449$, $p=.043$, counter to predictions, stress did not specifically intensify memory for negative emotional objects or impair the backgrounds on which they appear. Instead, in the stress condition, both negative $F=61.939$, $p<.001$, and neutral $F=10.905$, $p=.005$ objects were preferentially recognized compared to their backgrounds. These findings suggest that post-encoding stress exposure creates general tradeoffs in memory, irrespective of valence. This may be useful in stressful situations where the next potential danger is unknown but expected, e.g. soldiers on patrol.

PERCEPTION & ACTION: Audition

G70

NEURAL CORRELATES OF OBJECT BOUNDARY PERCEPTION IN THE AUDITORY SCENE Amanda McMullan[1], Dillon Hambrook[1], Artur Luczak[1], Matthew Tata[1]; [1]University of Lethbridge — Boundaries between perceptual objects in the visual modality can be defined by differences in luminosity, color, texture, and depth. The brain's mechanisms for identifying these boundaries have been well studied, but the analogous mechanisms in the auditory domain have gone relatively unexplored. We investigated the electrophysiological correlates associated with perceiving different types of auditory boundaries. We recorded brain electrical responses to boundaries defined by temporal discontinuities in pitch or acoustic energy using dense-array electroencephalography (EEG). We created pitch stimuli that were energy-matched to the noise background by using a delay-and-add algorithm for generating iterated rippled noise (IRN). Sound stimuli consisted of either white noise or a noise-IRN-noise sequence. We compared Event-related Potentials (ERP) time locked to these different kinds of boundaries, along with associated spectral power and inter-trial phase coherence of the EEG. We report differences in the N1 component of the ERP as well as differences in spectral power and inter-trial phase coherence in the theta EEG band.

G71

THE DORSAL AUDITORY STREAM'S ROLE IN PITCH TRANSFORMATIONS AND COMPARISONS Jean Mary Zarate[1], David Poeppel[1]; [1]New York University — The functional roles attributed to the dorsal auditory stream include spatial localization, spectrotemporal processing for music and speech, auditory-motor transformations, and feedforward-feedback comparisons. We suggest that the dorsal stream may serve a general computational role that can help disambiguate these putative functions. In an fMRI study, we focused on the dorsal stream's computational role during spectrotemporal processing by testing musicians and non-musicians with pitch-interval comparison tasks; we also evaluated the effects of musical experience on dorsal-stream activity. Subjects selected the larger of two pitch intervals presented either at 225 Hertz (fixed condition) or at 225 and 475 Hertz (roving condition). In each condition, pitch

distances between intervals (or interval-differences) were parametrically varied (25-175 cents). Activity within planum temporale and parietal regions (i.e., the dorsal stream) increased as a function of interval-difference, and musicians recruited more activity in these areas than non-musicians. After measuring group discrimination thresholds in each condition, we contrasted hemodynamic responses during suprathreshold interval comparisons with responses during subthreshold comparisons. Suprathreshold comparisons engaged non-musicians' pre-supplementary motor area in the fixed condition and planum temporale in the roving condition, compared to subthreshold comparisons. Musicians recruited the dorsal stream more extensively (e.g., intraparietal sulcus, premotor cortex, anterior insula) than non-musicians in both conditions. We conclude that the dorsal auditory stream is engaged during computations underlying pitch transformations and comparisons, and it is recruited to a greater degree after extensive musical experience. These results will inform our future studies on the dorsal stream's computational role during spatial localization and auditory-motor transformations.

G72

STATISTICAL CONSTRAINTS IN THE AUDITORY DOMAIN IMPACT WHOLE-BRAIN CONNECTIVITY PATTERNS OF THE ANTERIOR CINGULATE AND HIPPOCAMPUS Samuel Nastase[1], Vittorio Iacovella[1], Uri Hasson[1]; [1]CIMeC - Center for Mind/Brain Sciences, University of Trento, Italy — Statistical constraints pervade our auditory environment and may play a crucial role in language and active perception. Several proposals regarding the neural systems that code for order have implicated the anterior cingulate cortex (ACC) and hippocampus. However, the processes underlying this sensitivity remain unclear; in particular, it is unknown how functional connectivity of ACC or hippocampus is modulated by statistical constraints governing inputs. Here, fMRI was used to address this issue with regard to auditory stimuli. Participants listened to four audio series, each 2.5 minutes long. The four series differed as a function of statistical constraints determining the transition probabilities (Markov Entropy) of tones within each series: one series was random, two were moderately ordered, and another was highly ordered. We identified regions tracking order linearly (more/less connectivity as a function of order) or via U-shaped connectivity profiles (differentiating mid-level order from both high and low levels). Physiological noise was removed to isolate functional connectivity. Connectivity with the seed areas was modulated by order mainly in frontal, parietal, insular, and left parahippocampal regions. Importantly, two connectivity profiles emerged as predominant for both seed regions: positive linear relations between order and connectivity (stronger connectivity for greater order), and U-shaped relations in which high and low levels of order elicited greater connectivity than intermediate levels. These connectivity profiles suggest two functionally orthogonal processes underlying the brain's sensitivity to auditory order. While some regions may encode the degree of order linearly, others, characterized by U-shaped connectivity profiles, may instead code for input complexity.

G73

SUBCORTICAL CORRELATES OF STATISTICAL LEARNING Erika Skoe[1], Emily Spitzer[1], Nina Kraus[1]; [1]Northwestern University — Extracting patterns from continuous sound sequences, a process called statistical learning, is fundamental to acquiring music skills and language. Drawing upon the knowledge that the auditory brainstem is sensitive to regularly-occurring and predictable sounds (within one's native language or a novel sound sequence), we posited that statistical learning dynamically involves subcortical structures. To test this, we recorded auditory brainstem response (ABRs) while adult participants listened passively to 15-minute continuous sequences (composed from 8 tones) containing either no re-occurring patterns or four re-occurring patterns. Across the conditions, each of the 8 sounds was presented with the same probability. When participants were tested on their ability to recognize the patterns in isolation, they performed above chance. A comparison of the ABRs between conditions revealed that the response was attenuated in the patterned condition. To confirm that this was reflective of learning and not context-dependent encoding, in another group of subjects (age-, sex- and IQ-matched), we recorded ABRs to a different set of patterns (composed from the same sounds) that formed a less musical-sounding sequence. In this case, behavioral performance was below chance and, notably, the ABR was equivalent between the patterned and unpatterned conditions Although the brainstem has been assumed to be important for auditory learning, by using identical stimuli to compare learning outcome and neural plasticity, we present the first validation of this hypothesis. Moreover, our results suggest that learning-related subcortical processes are mediated by cognitive factors, including the listener's implicit knowledge of musical structure.

G75

IS RHYTHMIC SYNCHRONIZATION IMPAIRED IN PARKINSON'S DISEASE? Nathaniel Miller[1], Youngbin Kwak[2], Melanie Sottile[3], Martijn L.T.M Muller[1], Nicolaas Bohnen[1], Jin Bo[4], Praveen Dayalu[1], Rachael D. Seidler[1]; [1]University of Michigan, [2]Duke University, [3]National Institutes of Health, [4]Eastern Michigan University — Disturbed internal rhythm generation is hypothesized to underlie gait and speech symptoms of Parkinson's disease (PD; Freeman, Cody, & Schady, 1993). Impaired rhythm perception and production in PD support this hypothesis, suggesting a role for the basal ganglia and/or dopamine in rhythm generation (Grahn & Brett, 2009). One task used to assess rhythm generation has individuals synchronize finger taps with an external, equally-timed tone sequence and continue tapping at the same target rate without tones. Traditional dependent measures are the mean and variability of the produced time intervals. However, these measures neglect the degree to which individuals can synchronize with pacing tones and internally maintain synchrony without external pacing tones. We used directional statistics to compare the phase relationship (synchrony) between finger taps and a target rate while pacing tones were either present or absent. Twenty-nine mild-to-moderate PD patients and 46 healthy controls tapped with the index finger of their right- and left-hands at target time intervals of 500, 1000 and 1500 ms. Patients were tested ON and OFF levodopa. To date, our analyses suggest worse synchronization for PD ON when pacing tones are present—but not when absent—relative to healthy controls. This difference is greatest at 500 ms when PD patients tapped with their more affected hand while medicated. These findings suggest that one aspect of motor timing impaired in medicated PD patients is the ability to synchronize hand tapping with an external rhythm at faster rates, but we found no evidence for impaired internal rhythm generation in PD.

G76

ADAPTATION TO CHANGE IN SENSORIMOTOR SYNCHRONIZATION: TAPPING PERFORMANCE CORRELATES WITH AUDITORY ERPS Michael Schwartze[1], Maren Schmidt-Kassow[2], Sonja A. Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Johann Wolfgang Goethe-Universität, Frankfurt am Main, Germany — The ability to synchronize the internal mechanisms that underlie cognition and action with external events is essential in order to cope with an inherently dynamic environment. The notion of an event implies some perceived change in the formal and/or temporal layout of the environment. In the current study we used simultaneous behavioral and EEG recordings to investigate the relation between sensorimotor synchronization (finger-tapping) and the processing of change (auditory deviance processing). Participants listened attentively to sequences consisting of equidurational (100 ms) sinusoidal tones with a base tempo of 600 ms while they aligned finger taps starting with the third tone of a sequence. Following a variable number of standards (4-7, 600Hz), deviant events changed the formal and/or temporal structure of the sequence. Deviant events were tones that differed from the standards in either pitch (660 Hz), tempo (-75 ms inter-stimulus-interval), or a combination of both. The quality of the tapping performance was assessed in terms of variability of asynchronies between the tones and the taps as well as in terms of error correction esti-

mates (phase- and period correction). Amplitude and latency of event-related potentials (N2b, P3b) indexed the quality of auditory deviance processing. The results confirm a strong relation between these measures, suggesting that sensorimotor synchronization influences deviance processing and vice versa.

G77

MUSICAL EXPERIENCE ACROSS THE LIFESPAN: IMPLICATIONS FOR PERCEPTUAL AND COGNITIVE ABILITIES Alexandra Parbery-Clark[1], Samira Anderson[1], Emily Hittner[1], Travis White-Schwoch[1], Nina Kraus[1]; [1]Northwestern University — Increasing evidence suggests that younger and older adult musicians have greater perceptual acuity and auditory-based cognitive abilities than age-matched nonmusicians. However, it is currently unknown whether these effects are due to an advantage that is sustained and consistent throughout adult life or whether musical training actually offsets the aging trajectory. To assess this, we measured auditory perceptual and cognitive abilities in 180 musicians and nonmusicians ranging from 18 – 77 years old. Outcomes reveal that musicians experience less age-related decline for certain perceptual and cognitive tasks (e.g., backward masking, frequency discrimination and auditory working memory). Whereas for other tasks, such as speech-in-noise perception (e.g., QuickSIN and HINT), the extent of the musician advantage remains constant across the lifespan. These results suggest that the impact of musical experience on sensory-cognitive processes varies depending on the nature of the task, highlighting the multi-faceted effects of music on the nervous system.

G78

THE EFFECTS OF TINNITUS AND AGE ON RESTING STATE FUNCTIONAL CONNECTIVITY Sara Schmidt[1], Kwaku Akrofi[1], Jake Carpenter-Thompson[1], Fatima Husain[1]; [1]University of Illinois — The purpose of the study was to examine the effects of tinnitus and hearing loss on resting state functional connectivity. Our hypothesis was that increased activity would be present in the auditory pathway of patients with tinnitus at rest. Three groups of subjects were examined in this experiment: individuals with tinnitus and hearing loss (TIN) and individuals with normal hearing (NH). Resting state functional connectivity data was collected for each group using functional magnetic resonance imaging (fMRI). Subjects were asked to stare at a fixation cross for five minutes and performed no other task. Group independent component analysis using GIFT as a MATLAB toolbox was performed to analyze the data, followed by region of interest (ROI) analysis. The ROI was located at either the left or the right primary and secondary auditory cortices (corresponding to Brodmann areas 41, 42, and 22). Preliminary results of the ROI analysis revealed differences in connectivity maps between the TIN and NH groups; the TIN group, but not the NH group, showed extensive connectivity with superior and middle temporal gyri. The results suggest altered connectivity in the auditory processing regions in individuals with TIN in a non-task directed experiment. Further studies will examine the effects of aging on these connectivity patterns.

G79

HIGH-RESOLUTION IMAGING REVEALS TONOTOPIC ORGANIZATION IN HUMAN AUDITORY MIDBRAIN Bharath Chandrasekaran[1], Seth Koslov[1], Evan Luther[1], David Ress[1]; [1]The University of Texas a Austin — A major challenge for auditory neuroscience is to discover how spectrotemporal information is mapped along the auditory pathway. Experiments in animals reveal detailed maps of frequency information along the dorsoventral dimension within the central nucleus (CN) of the inferior colliculus (IC), the primary auditory midbrain structure (1-4). Existence of tonotopic maps has not yet been evaluated in human IC due to the limited spatial resolution of fMRI. In the current experiment, we measured functional activity from the central nucleus (CN) of the IC using a phase-encoded approach at a 1.2 mm voxel size to capture laminar activity variations in response to auditory stimulation. Stimuli consisted of a random phase noise-carrier filtered through pass bands that differed in spectral content (systematically proceeding from low to high frequencies). Participants performed a challenging frequency discrimination task in the scanner to ensure attention to frequency content. Sinusoidal fits to the time series for each participant produced phase maps that encode stimulus frequency. The maps (thresholded at $p < 0.001$), showed a clear dorsal through ventral gradient for low-to-high frequencies, consistent with animal results. Depth profile measures using surface-based analyses from the CN and the dorsal cortex (DC, a portion of the IC that does not show tonotopic representation) confirmed that low-frequency responses are more superficial than high-frequency responses in CN, but not in DC. These results provide first evidence for the existence of detailed tonotopic maps in human auditory midbrain, a crucial first step needed to develop auditory midbrain prosthetic devices.

PERCEPTION & ACTION: Motor control

G80

EFFECTIVENESS OF UNILATERAL VERSUS BILATERAL DEEP BRAIN STIMULATION IN PATIENTS WITH PARKINSON'S DISEASE Melissa Wright[1], Rachael Seidler[1], Kelvin Chou[1], Parag Patil[1]; [1]The University of Michigan — Bilateral deep brain stimulation (DBS) of the subthalamic nucleus (STN) is the standard surgical treatment for patients with advanced Parkinson's disease (PD). Bilateral DBS increases "on" functioning states, reduces necessary medications, and decreases levodopa-induced dyskinesias. However, recent research suggests that bilateral stimulation can result in worse dual task cognitive-motor performance when compared with unilateral stimulation. The goal of this study was to expand cognitive-motor assessments during unilateral and bilateral DBS. We tested 18 PD patients (16 right and 2 left-handed) with bilateral STN DBS while off medication under conditions of bilateral stimulation (BStim) and unilateral stimulation (UniStim) to each side. Grasp force timing was assessed by utilizing a continual sine wave tracking grasp/release task with peak target force set at 20% of maximal grasp force for each hand. The force tracking was performed under single and dual task conditions using a spatial and verbal working memory task as a secondary cognitive load. Temporal force tracking was significantly worse on the left hand during all stimulation conditions. Ipsilateral UniStim resulted in poorer performance on the right hand with dual verbal working memory loads, whereas improved performance was seen under BStim and ipsilateral UniStim on the left hand with spatial memory loading. Right and left hand tracking did not differ with task complexity for other conditions. These findings suggest temporal grasp control is better with BStim; however UniStim may be differentially as effective for grasp control depending on the side of stimulation and type of cognitive working memory load.

G81

THE ORIGIN OF IMAGES THROUGH DRAWING: A FUNCTIONAL MRI STUDY Steven Brown[1], Ye Yuan[1]; [1]McMaster University — Images refer to visual patterns created on surfaces. The human capacity to generate images dates back more than 30,000 years. However, there are relatively few neuroimaging studies devoted to its neural basis. We took advantage of a newly-developed MRI-compatible drawing tablet in order to examine this capacity. Subjects participated in a series of scribbling tasks in which they were cued to create geometric patterns (spirals, zigzags, serpentines) on the tablet's surface. The critical comparison was between when visual feedback was displayed on the tablet's screen (image generation) versus when it was not (no image generation). Whereas drawing with no image generation led mainly to activations in the motor cortex and cerebellum, image generation led to additional activations in areas involved in sensorimotor integration (intraparietal sulcus, precuneus) and motion perception (area V5, frontal eye fields), reflecting the linkage between drawing movements and the images that result from them. Interestingly, these same areas were also activated during a motion-perception task in which subjects viewed animations of visual patterns emerging in the drawing space of the tablet's surface. Hence, image generation through drawing appears to be an offshoot of embodied motion-

perception mechanisms, in particular those that link visual marks with the drawing movements that elicit them in real time.

G82

SUPPRESSION OF EEG MU RHYTHMS DURING PHANTOM LIMB PAIN THERAPY Thomas Fikes[1], Alexis Youngberg[1], Megan Seymour[1], Elizabeth Franz[2]; [1]Westmont College, Santa Barbara, CA, [2]University of Otago, Dunedin, NZ — Suppression of mu rhythms (electroencephalograph [EEG] power in the 8-12 Hz band over sensorimotor cortices) is typical during movement, imagined movement, and observed movement. In order to observe the relation of mu suppression to the experience and treatment of phantom limb pain, EEG was recorded in a lower-limb amputee during simple movement tasks that heightened the subjective experience of the phantom limb in order to observe mu suppression over the six-week course of self-directed mirror therapy aimed at reducing phantom limb pain. The experimental task involved bilaterally symmetrical movements of either upper or lower limbs, and movements were performed on either side of a mirror in the mid-sagittal plane that was uncovered (i.e., identical to therapy, creating the visual illusion of intact lower limbs), covered (precluding vision of the amputated limb), or absent. Mu suppression over the hemisphere ipsilateral to the amputated limb was of typical amplitude and location (centered over parietal lobe; EEG channel CP3), but was abnormal over the contralateral hemisphere showing almost no mu-band power during rest, and therefore no suppression during movement. Over six weeks of therapy, there was minimal reduction in self-reported pain and no change in the lateralized mu-suppression pattern. Ongoing work with this participant focuses on the possibility that resting mu-rhythm power may need to be restored in the contralateral hemisphere before normal mu-suppression and therapeutic efficacy will be possible.

G83

RESTING STATE CORTICO-CEREBELLAR FUNCTIONAL CONNECTIVITY PATTERNS OF THE CEREBELLAR LOBULES AND VERMIS Jessica A. Bernard[1], Scott J. Peltier[1], Kelsey M. Hassevoort[1], Jillian Lee Wiggins[1], Susanne M. Jaeggi[1], Martin Buschkeuhl[1], John Jonides[1], Christopher S. Monk[1], Rachael D. Seidler[1]; [1]Univeristy of Michigan — Individual lobules of the cerebellum project to distinct regions of the cortex, as shown using tract tracing in non-human primates, and with diffusion weighted imaging in humans. However, it remains unknown how the individual lobules of the cerebellum interact with the cerebral cortex, and what this means for behavior. Resting-state functional connectivity magnetic resonance imaging (fcMRI) allows for the investigation of functional networks in the human brain. While some researchers have begun to employ this technique to study the human cerebellum, none have taken an anatomically driven approach. In this study, we used fcMRI to investigate the functional networks of the cerebellar lobules of the right hemisphere and vermis in healthy right-handed young adults (N=33, 22.76 + 2.95 years, 15 female). We found distinct networks for the individual lobules with a clear division into "motor" and "non-motor" regions. Crus I and Crus II show a network consisting largely of prefrontal and parietal regions, while Lobule VI is part of a network with frontal and parietal regions as well as premotor regions. Lobules I-V are part of distinct networks relating to motor cortical regions of the brain as well as the cingulate cortex. Finally, Lobules VIIb, VIIIa, VIIIb, and X are part of multimodal networks including temporal, limbic and somatosensory regions of the cortex. Independent components analysis will be implemented to determine connectivity redundancies within the cerebellar lobules. Our results demonstrate motor and cognitive dissociations within the cerebellar lobules consistent with results using invasive tract-tracing techniques.

G84

HABITUATION TO SENSORY STIMULI IN TOURETTE SYNDROME Beth A Belluscio[1], Mark Hallett[1]; [1]NINDS, NIH — Tourette syndrome (TS) is defined by motor tics: actions made due to an irresistible urge to act. The urge arises from an uncomfortable bodily sensation. TS patients are also bothered by mild, non-salient, external sensations. The mechanism underlying this sensory sensitivity is unknown. We hypothesized that TS patients habituate less to repetitive stimuli. We administered auditory or tactile stimuli in 120 trains of 3 at 1Hz. Brain activity in TS patients and healthy volunteers (HVs) was recorded using magnetoencephalography (MEG). Responses to the first, second, and third stimuli of the train were averaged separately. We measured peak amplitude of the event-related field for the 10 most active MEG sensors. Habituation was expressed as a percent of the response to the first stimulus. We initially measured the m100 peak in response to an auditory stimulus in HVs (n=6) and TS patients (n=6). In HVs, habituation of the second response was 55% relative to the first, and the third was 57%. In TS patients, the response to the second stimulus was habituated 47% and the third was 51%, which did not represent a significant difference from the HV population. However, it is possible that ongoing analyses will reveal TS patients to have reduced habituation of earlier responses, such as the m50, of responses localized to other cortical regions, such as prefrontal cortex, and/or of responses to tactile stimuli.

G85

CHANGES IN MOTOR CORTEX ACTIVATION AFTER HYPOXIC EXPOSURE AND ENDURANCE EXERCISE INVESTIGATED BY FMRI E. Cousin[1,2], T. Rupp[3], M. Jubeau[3,5], L. Lamalle[2], J. Warnking[2], F. Esteve[2], Jp. Micallef[4], Gy. Millet[3,5], B. Wuyam[3], S. Vergès[3]; [1]Psychology and Neurocognition Laboratory, UMR CNRS 5105, Université Pierre Mendès-France, Grenoble, France, [2]SFR 1 « RMN Biomédicale et Neurosciences », Grenoble Hospital, France, [3]HP2 Laboratory (INSERM U 1042), Joseph Fourier University, Grenoble, France, [4]Movement To Health Laboratory (M2H), Montpellier-1 University, Montpellier, France, [5]Exercise Physiology Laboratory (EA 4338), Lyon University, Saint-Etienne, France — Hypoxia impairs whole-body exercise performance as illustrated by a loss of maximal aerobic power or a reduction in endurance capacities. Underlying mechanisms include increased fatigability at the muscle (peripheral) level but central (supraspinal) alterations could also partly explain this performance decrement. This study aimed at assessing effects of hypoxia by performing a prolonged fatiguing cycling exercise on motor cortex activation during intermittent knee extensions. Ten healthy subjects performed three 10-h experimental sessions (consisted in (i) breathing a gas mixture with an inspiratory oxygen fraction (FiO2) of 12% for 10 h at rest, (ii) breathing a gas mixture with FiO2=12% for 10 h and cycling for 4 h at 45% of the maximum power output between the 4th and 9th hours and (iii) breathing a gas mixture with FiO2=21% (normoxia) for 10 h and cycling for 4 h at 45% of the maximum power output between the 4th and 9th hours) including fMRI investigations in the first and last hours for each session, respectively. The parameter estimates (% signal change for each condition) were extracted from each functional motor ROI and the values were compared by means of a two-way ANOVA analysis with hypoxia/normoxia and pre/post-fatiguing exercise as within-subject factors. The ANOVA revealed significant main effect of hypoxia (increase of cerebral activation) explained by cortical excitability and significant interaction between hypoxia/normoxia and pre/post-fatiguing exercise with an increase of the degree of cerebral activation in hypoxia, which is increased following a prolonged fatiguing exercise, suggesting a balance between central and peripheral fatigability.

G86

THE ROLE OF THE TEMPOROPARIETAL JUNCTION (TPJ) IN ACTION PERCEPTION Moritz F. Wurm[1,2], Ricarda I. Schubotz[1,2]; [1]Max Planck Institute for Neurological Research, Cologne, [2]Westfälische Wilhelms-Universität, Münster — Observing hand-dominant object manipulations from the third person (3pp) compared to the first person perspective (1pp) increases neural responses in the temporoparietal junction (TPJ; Wurm et al., HBM, 2011). TPJ involvement may reflect a visuospatial transformation of the action to facilitate the match with the observer's egocentric frame of reference. The present functional imaging study sought to investigate the role of TPJ in the transformation of action parameters by employing a 2x2 factorial design: Subjects were instructed

to recognize actions that were shown (1) from either the 1pp or the 3pp, and (2) in either a natural or a pixelated fashion. In the pixelated variants, objects were not identifiable and actions had to be inferred by analyzing the movement kinematics of the action. We hypothesized increased TPJ responses for both natural and pixelated actions shown from the 3pp vs. 1pp. In the absence of object information, however, transformation of movement kinematics might be particularly important for action recognition. We therefore expected TPJ activation to be strongest for pixelated actions shown from the 3pp. Corrected whole-brain analyses revealed that observing 3pp vs. 1pp actions increases neural activity in the TPJ bilaterally, but only when actions were presented in a natural way. This finding suggests that transformation of action parameters requires precise visual information about hands and objects, which is absent when actions are pixelated. Together, results corroborate the notion that TPJ provides the neural substrate for perspective taking during observation of natural hand-dominant actions perceived from the 3pp.

PERCEPTION & ACTION: Vision

G87

3D INFORMATION IN FACE RECOGNITION: AN EYE-TRACKING STUDY Olga Chelnokova[1], Bruno Laeng[1]; [1]Department of Psychology, University of Oslo — One unresolved question about face perception is: what is the role of three-dimensional information in face recognition? In this study, recognition performance was compared across changes in viewpoint in different depth conditions: a 2D condition without stereo information and a 3D condition, where stereo information was present (by viewing the same face images as anaglyphs through the 3D glasses). Subjects' eye-movements were recorded during both 3D and 2D sessions. The findings revealed that participants were more accurate in the 3D condition. Moreover, individual differences in inter-pupillary distance also predicted recognition performance in the 3D but not in the 2D condition. A 'region of interest' analysis of gaze data showed that rich volumetric properties provided by certain facial features (e.g., the nose and the cheeks) were attended more in the 3D condition compared to the 2D condition. Taken together, these findings support the conclusion that face recognition across viewpoint transformation is facilitated by the addition of stereoscopic depth cues.

G88

TRACKING DYNAMIC IMPACTS OF DIGESTIVE HORMONES ON BRAIN MECHANISMS OF FOOD EVALUATION FOLLOWING GASTRIC BYPASS SURGERY Claudia Lietti[1], Léonie Egli[3], Vanessa Campos[3], Rosanna de Meo[2], Luc Tappy[3,4], Vittorio Giusti[4], Micah M.Murray[1,2,5], Ulrike Toepel[5]; [1]The Functional Electrical NeuroimagingLaboratory, Radiology Department, Centre HospitalierUniversitaireVaudoisand University of Lausanne, Switzerland, [2]The Functional Electrical NeuroimagingLaboratory, Department of Clinical Neurosciences, Centre HospitalierUniversitaireVaudoisand University of Lausanne, Switzerland, [3]Department of Physiology, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Switzerland, [4]Service of Endocrinology, Diabetes, and Metabolism, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Switzerland, [5]EEG Brain Mapping Core, Center for Biomedical Imaging of Lausanne and Geneva, Switzerland — Food intake and nutritional behaviour are known to be regulated by several gastro-intestinal (ghrelin, GLP-1, PYY) and endocrine (insulin, leptin) factors in animals. In terms of human nutritional behaviour, direct links and correlations between gastrointestinal (GI) or endocrine signals and reactions of the central nervous system have so far been seldom investigated. In this interdisciplinary study, combining methods for the monitoring of gastric hormones linked to glucose homeostasis and electrical neuroimaging, we aim to determine the parallels between Roux-en-Y gastric bypass (RYGB) - and its associated effects on gastric hormone levels and eating behaviour - and brain activity during pre-ingestion discrimination of food images. In particular, hormone blood measures are correlated with neural responses as measured by electroencephalography (EEG) in RYGB patients before and after food intake as well as in weight matched healthy normal-weighted and over-weighted control subjects without surgery. Preliminary results of this ongoing study will be presented.

G89

EQUALLY INVISIBLE BUT NEURALLY UNEQUAL: CORTICAL RESPONSES TO INVISIBLE OBJECTS VARY WITH PRESENTATION METHOD Sergey Fogelson[1], Kevin Miller[2], Peter Kohler[1], Richard Granger[1], Peter Tse[1]; [1]Dartmouth College, [2]Princeton University — Visual stimuli presented without any corresponding visual experience may still lead to neural processing (Moutoussis & Zeki, 2002). It is unknown whether such responses differ as a function of the method used to prevent stimuli from entering awareness. We asked whether two means of making stimuli invisible (chromatic flicker fusion and continuous flash suppression) had different effects on object processing within the human brain. Using functional magnetic resonance imaging (fMRI) we presented subjects (N=15, 9 males) with face and tool stimuli that were either fully visible or rendered invisible using either method. Whole-brain decoding showed that both category and, surprisingly, subcategory-level information was present when stimuli were visible and invisible. However, the cortical and subcortical response pattern differed as a function of stimulation method. Chromatic flicker fusion permitted decoding within a set of cortical and subcortical regions that were largely nonoverlapping with regions that participate in decoding stimulus category and subcategory during continuous flash suppression. These results have implications for studying the neural correlates of consciousness, suggesting that fine-grained subcategory-level information is available in the absence of awareness. Furthermore, they indicate that the method used to prevent stimuli from reaching awareness should be tailored to the specific mechanisms or brain regions being studied.

G90

IN AND OUT OF CONSCIOUSNESS: SUSTAINED ELECTROPHYSIOLOGICAL ACTIVITY REFLECTS INDIVIDUAL DIFFERENCES IN PERCEPTUAL AWARENESS Carson Pun[1], Stephen M. Emrich[2], Kristin E. Wilson[1], Erene Stergiopoulos[1], Susanne Ferber[1,3]; [1]Department of Psychology, University of Toronto, [2]Department of Psychiatry, University of Wisconsin–Madison, [3]Rotman Research Institute, Baycrest — Although significant advances in our understanding of the cognitive and neural processes involved in conscious awareness have occurred in recent years, the precise mechanisms that support consciousness remain elusive. Examining the neural correlates associated with the moment a stimulus enters or exits conscious awareness is one way to potentially identify the neural mechanisms that give rise to consciousness. In the present study, we recorded neural activity using electroencephalography (EEG) while participants observed a bilateral shape-from-motion (SFM) display. While the display is in motion, the observer perceives an object that is immediately segregated from a noisy background. After the motion stops, the observer's experience of the object remains momentarily in awareness, before it eventually fades out of consciousness back into the noisy background. Consistent with subjective reports of perceptual experience, we observed a prominent sustained posterior contralateral negativity known as the contralateral delay activity (CDA). This activity was sustained only in conditions associated with sustained awareness. Interestingly, the amplitude of the CDA was correlated with individual differences in visual awareness, suggesting that this activity plays a significant role in the maintenance of objects in consciousness. The CDA is typically associated with visual short-term memory (VSTM), suggesting that conscious visual awareness may be mediated by the same neural and cognitive mechanisms that support VSTM. Our results demonstrate that the CDA may reflect the contents of conscious awareness and therefore can provide a measure to track when information moves in and out of consciousness.

G91

NEURAL DIFFERENCES IN TRANSLATING ABSTRACT VERSUS CONCRETE VISUAL REPRESENTATIONS INTO ACTIONS Andrew Butler[1], Bennis Pavisian[1], Karin James[1]; [1]Indiana University — Using visual information to perform actions is a fundamental aspect of human behavior. Musicians commonly translate visual information into action, and many can use different types of visual information, ranging from concrete to abstract, to perform the same action. To investigate how visual information affects translations into action, we exposed expert guitarists to four types of visual depictions of action instruction including musical notation (very abstract), tablature (abstract), chord diagrams (more concrete), and actual pictures of guitars chords being formed (very concrete). All forms of visual information were familiar, and frequently used by the participants when playing guitar. Visual information was shown during fMRI scanning as the guitarists formed the appropriate chords (as visually depicted) on a magnet safe guitar fret board with nylon strings, or where they simply viewed the visual stimuli without an action. The design of this study gives us the unique ability to equate motor actions while comparing the translation of vision to action across levels of abstraction. Results of direct, and linear, whole brain contrasts showed that, during the translation of visual information to actions, activation in bilateral posterior parietal cortex (PPC) was increased as the degree of visual abstraction increased. These results suggested that the PPC plays a key role in translating visual information into motor actions, but more importantly suggests that PPC activation is directly related to the concrete-abstract continuum of visual stimuli. The current findings highlight that the degree of visual abstraction is an important factor modulating visual-motor processing.

G92

CORRECTION OF VISUAL DYSFUNCTION FOLLOWING TRAUMATIC BRAIN INJURY DURING STROOP COLOR-NAMING TASK Caitlin M. Hudac[1], Nathan Petro[1], Katie Meidlinger[1], Roxanne Haslam[1], Srinivas Kota[1], James Nedrow[2], Dennis Molfese[1]; [1]University of Nebraska-Lincoln, [2]Oculi Vision Rehabilitation — Vision dysfunction is common following traumatic brain injury (TBI), often resulting in Post-Trauma Vision Syndrome (PTVS). Neuro-optometric rehabilitation is available through the use of corrective lenses and prisms. However, little is known about the neural mechanisms engaged during neuro-optometric rehabilitation during cognitive tasks. The goal of this study was to use visual event-related potentials (VERPs) to assess neurocognitive mechanisms involved during a Stroop color-naming task both with and without prisms. A patient with PTVS observed color words presented for 150 ms with congruent (80% frequency) or incongruent (20% frequency) colored font. Single-trial analyses for each observation (with and without prisms) for both congruent and incongruent conditions were conducted. VERP waveforms were compared across observations, condition, and electrode cluster using principal components analysis (PCA) and analysis of variance (ANOVA). ANOVA results indicated 3 factors with significant interactions of observation accounted for 33% of the total variance. A significant 3-way interaction for Factor 6 (peak at 332 ms) occurred between observation (2: without prisms, with prisms), stimulus condition (2: congruent, incongruent), and electrode cluster (18) using the Huynh-Feldt correction ($F(17,255) = 2.69$, $p < .035$, observed power = .74). Scalp topographies for the P332 ms component derived from Factor 6 of the PCA indicated comparable peak amplitudes for the congruent condition both with and without prisms. However, during the incongruent condition, peak latencies do not occur without prisms, suggesting reduced neural mechanisms for processing conflicting information. The use of neuro-optometric rehabilitation corrects symptoms specific to visual dysfunction as well as cognition.

G93

ERP SIGNATURES ASSOCIATED WITH BIOLOGICAL FORM AND BIOLOGICAL MOTION PROCESSING DURING ACTION PERCEPTION Burcu Aysen Urgen[1], Markus Plank[1], Marta Kutas[1], Howard Poizner[1], Ayse P. Saygin[1]; [1]University of California, San Diego — The processing of others' actions is both ubiquitous and important. Here, we studied the role of visual form and visual motion kinematics of the observed agent in action processing using a stimulus set of human and humanoid robot actions. Event-related brain potentials (ERP) were recorded while participants viewed 2s videos of three agents (Human, Android, Robot) performing recognizable actions: Human had biological form and motion, Android had biological form and non-biological motion, Robot had non-biological form and non-biological motion. Android and Robot were the same moving machine in two different appearances disguised via two different appearances, and thus featured identical kinematics. We found distinct neural signatures for processing of biological form and motion, as well as for congruence of form and motion. Form-sensitive modulation was characterized by 1) a negativity between 210-400 ms over centro-parietal, central, and fronto-central regions bilaterally, 2) a positivity between 270-370 ms over left parietal areas, both more pronounced for Robot compared with Human and Android. There was some evidence for biological motion-sensitivity between 130-230 ms, over left parieto-occipital regions, Human being more pronounced than Android. There was also evidence for a neural signature for processing form-motion congruence in frontal channels between 150-250 ms, where the Android condition differed from Robot and Human. These results highlight differential spatiotemporal cortical patterns in action perception that depend on the viewed agent's form and motion kinematics.

G94

PREFERENTIAL PROCESSING OF LEFT HEMIFACE INFORMATION IN HEARING BUT NOT DEAF ADULTS. Susan M. Letourneau[1,2], Teresa V. Mitchell[3]; [1]NYU, [2]CUNY Graduate Center, [3]University of Massachusetts Medical School — Deaf users of American Sign Language (ASL) rely heavily on facial expressions for both linguistic and affective information. The current study tested the hypothesis that deafness and sign language use reduce the right hemisphere/left hemiface asymmetry commonly observed during face perception. Twelve hearing adults with no ASL experience, and 12 deaf adults who learned ASL by age five judged whether a target face had the same or different identity (in one task) or emotion (in another task) as a quickly presented prime face. Primes depicted either whole faces, right- or left-hemifaces (faces with the left and right sides blurred, respectively), and targets depicted whole faces. Accuracies, reaction times, and event-related potentials (ERPs) were recorded. While both groups of participants showed highest accuracies following whole face primes, only hearing adults showed higher accuracies in left- as opposed to right-hemiface trials, specifically during the emotion task. Face-sensitive ERPs in both groups were larger over the right hemisphere than the left. However, only the hearing group showed larger ERP amplitudes in response to left- than right-hemifaces, and similar ERP responses to left-hemifaces as whole faces. In contrast, ERPs in the deaf group demonstrated fewer and smaller differences between left- and right-hemiface trials, and greater differences between whole faces and both types of hemifaces. Therefore, while overall right hemisphere asymmetries were not altered in the deaf group, deafness and/or ASL experience appeared to reduce the preferential processing of information in the left side of the face.

G95

COGNITIVE CONTRIBUTIONS TO COLOR CONSTANCY; A CASE FOR A SUBJECTIVIST COLOR ONTOLOGY Abdul-Kareem H Ahmed[1], Mazviita Chirimuuta[1]; [1]University of Pittsburgh — The question of color realism, the existence of color and veridicality of color perception has troubled philosophers since the Ancient Greeks. With the advent of empirical cognitive sciences new advances have been made in our understanding of color perception. Some color scientists align with a physicalist view of

color perception, that colors may be reduced to physical properties of objects, such as spectral surface reflectance. A major contemporary proponent of this theory is David Hilbert (1987; Byrne and Hilbert 2003). In this study, we will show how an approach such as Hilbert's has the disadvantage of underestimating the cognitive contribution to color perception, using color constancy as an example. Though he acknowledges sensory and calculative mechanisms in the brain, he does not make reference to findings of cognitive mechanisms contributing to color constancy. We will argue that admitting a role for cognitive mechanisms would compel one to accept a level of subjectivism about color, not compatible with physicalism. The methodology of this study was philosophical, where scholarship by Hilbert was compared with recent studies of color constancy from the cognitive sciences (Smithson 2005). Data from these studies was compared to ideas proposed by Hilbert, and conflicts were discerned. These conflicts were then used to reach an understanding which more comprehensively aligns with the cognitive sciences. Ultimately, we conclude that color perception cannot be explained simply as the detection of physical stimuli.

G96

THE PREDICABILITY OF ACTION-EFFECTS MODULATES NEURAL RESPONSES IN THE SAME REGIONS DURING ACTION AND OBSERVATION John A Dewey[1], Thomas H Carr[1]; [1]Michigan State University — Previous neuroimaging studies (e.g. Farrer et al. 2008; Leube et al. 2003; Schnell et al. 2007; Spengler, Cramon, and Brass, 2009) have shown that a frontoparietal network including parts of ventral prefrontal and inferior parietal cortex is involved in predicting and monitoring visual consequences of one's own movements, or action-effects. In a rapid event-related fMRI study, we aimed to characterize which, if any, areas of this frontoparietal network are specific to self-monitoring, and which are involved in predicting visual action-effects without regard for source. Results from two experiments show that neural responses in many frontal and parietal areas were modulated by predictability and by agency (acting v. observing), but no regions showed a two-way interaction, suggesting a great deal of overlap between networks involved with predicting and monitoring visual action-effects during direct action and observation.

G97

MODULATION OF VENTRAL PREMOTOR CORTEX BY INTERPERSONAL LIKING Mona Sobhani[1,2], Glenn R. Fox[1,2], Jonas Kaplan[2,3], Lisa Aziz-Zadeh[2,4]; [1]Neuroscience Graduate Program, University of Southern California, [2]Brain and Creativity Institute, University of Southern California, [3]Department of Psychology, University of Southern California, [4]Department of Occupational Therapy, University of Southern California — Observing an action involves regions involved in motor planning, such as the inferior frontal, premotor, and inferior parietal regions. Recent research suggests that during action observation, activity in these neural regions is modulated by ethnic group membership and physical properties of the person performing the action. In this study, we investigated whether likability modulates activity in neural regions involved in action observation. Seventeen Jewish subjects were familiarized with biographies of eight individuals, half of which belonged to Neo-Nazi groups (dislikable) and half of which did not (likable). All subjects and actors in the stimuli were Caucasian, and thus physically similar. The subjects then viewed videos of actors portraying the characters performing simple motor actions (e.g. grasping a water bottle and raising it to the lips), while undergoing fMRI. Using multivariate pattern analysis (MVPA), we found above chance classifier accuracy in the right ventral premotor cortex when the classifier was trained and tested on the likable and dislikable action observation conditions. This data indicates that activity in the premotor cortex is modulated by likability even when watching a simple action like reaching for a cup.

G98

HOW TALL ARE WE FOR A NEGLECT PATIENT? IT DEPENDS ON WHERE WE ARE. Silvia Savazzi[1], Lucio Posteraro[2], Alessia Manfredini[1,2]; [1]University of Verona and National Institute of Neuroscience, Italy, [2]Rehabilitation Medicine Unit, Suzzara Hospital, Mantova, Italy — Neglect patients tend to judge the leftmost stimulus of two equally long objects as being shorter than the rightmost object. This effect seems to be due to a distortion of space: space in neglect patients is represented as progressively relaxed toward the contralesional space and progressively compressed toward the ipsilesional one (the space anisometry hypothesis). To test this hypothesis we took advantage of an illusion we have recently described: healthy subjects judge the thinner of two equally tall stimuli as being taller. Thus, the horizontal extent of a stimulus is not neutral with respect to the perceptual judgment that has to be made on its vertical extent: the wider the stimulus the shorter it is judged. Accordingly, we expect that the leftmost of two stimuli of the same horizontal and vertical size will be judged by neglect patients as shorter, as a consequence of a misrepresentation of the stimuli along the horizontal dimension. Here, neglect patients, brain-damaged patients without neglect and healthy subjects were asked to judge the vertical extent of rectangles and bodies. Only neglect patients judged the leftmost of two identical stimuli (tall and large the same) as being shorter on 75.78% of trials, whereas brain-damaged patients without neglect and healthy subjects judged the leftmost stimulus as being shorter on 46.45% of trials (chance level). The misjudgment of the vertical extent found with neglect patients is interpreted as due to a misrepresentation of the horizontal dimension (irrelevant to the task), thus in line with the space anisometry hypothesis.

G99

CONNECTIVITY IN CORTICAL NETWORKS DURING WORD READING Nicolas Bedo[1], Urs Ribary[2], Lawrence M. Ward[1]; [1]University of British Columbia, [2]Simon Fraser University — The neural processes underlying word-reading remain much of a mystery. In particular, the flow of information within and between language networks during word reading has not been adequately explored. The present study investigated local spectral power changes and functional and effective (causal) connectivity at each stage of word reading. EEG was used to record brain activity from healthy volunteers (n = 15), during a reading task. The task required participants to view a sequence of three letters, followed by a three-letter word. Participants were instructed to respond as to whether or not the word matched the letter sequence. Independent component analysis yielded many sources of activation previously identified as being crucial to word-reading. A combination of event-related spectral perturbation and phase synchrony analyses was performed on these independent components. Additionally, analyses of Granger causality were conducted to investigate the possible causal information flow between sites of interest. Analyses show local theta power increases prior to long-distance theta synchronization between several pairs of cortical sites, reflecting previously-established paths of activation involved in reading text. Additionally, causal connectivity was established between object recognition sites and semantic processing sites, suggesting a feed-forward flow of information. These results highlight the interplay between local and long-distance neural dynamics involved at each stage of processing during reading. Additionally, these measures of functional and causal connectivity may be used as a benchmark for comparison with clinical populations (e.g. individuals with certain kinds of dyslexia), such that disturbances in connectivity may provide insight as to underlying neurological problems.

G100

BODY SPECIFIC N170 COMPONENT IS ALTERED IN ANOREXIA NERVOSA Boris Suchan[1], Katharina Banscherus[1], Stephan Herpertz[2], Denise Soria Bauser[1]; [1]Institute of Cognitive Neuroscience; Ruhr University Bochum, [2]Clinic for Psychosomatic and Psychotherapy; Ruhr University Bochum — Recent findings demonstrated structural alterations in the so called extrastriate body area, a part of the extrastriate visual cortex that is

specialized for visual body processing, in women with anorexia nervosa. The current investigation aimed at looking at alteration in the body specific N170 EEG component in anorexia nervosa. A group of 14 women with diagnosed anorexia nervosa according to the DSM IV criteria were investigated using EEG and stimuli of human bodies. Houses served as control-stimuli. Results yield evidence for an increase of the N170 amplitude in anorexia nervosa compared to healthy controls. These findings yield additional evidence for altered visual body image processing in anorexia already at the level of early visual processing. To our knowledge, this is the first study yielding evidences for visual body processing related N170 changes in anorexia nervosa.

G101

APPLICATION OF FMRI ADAPTATION TO CHARACTERIZE THE NEURAL REPRESENTATION OF COLOR Andrew S Persichetti[1], Geoffrey K Aguirre[1], David H Brainard[1], Omar H Butt[1], Nina S Hsu[1], Sharon L Thompson-Schill[1]; [1]University of Pennsylvania — Color names may be used to divide the continuous spectrum of color percepts into discrete categories. We asked whether there is a transition from a continuous towards a categorical representation of color along the visual pathways from V1 to ventral extra-striate cortex. Ten subjects performed a behavioral color categorization task on 10 stimuli that varied along a green-blue continuum. Separately, these stimuli were presented in an fMRI experiment that employed a continuous carry-over design to estimate the response evoked by each color when preceded by every possible pair of colors. The fMRI measurements were obtained while subjects performed an orthogonal attention task. Retinotopic mapping and color localizer data were also collected. The behavioral data revealed the expected categorization, with a transition from "green" to "blue" labels occurring in the middle of the continuum. In the fMRI data, there was a recovery from adaptation within posterior visual areas that was related to the magnitude of the color stimulus transition. In ongoing analyses we are examining the precise form of this effect in separate visual areas, and testing whether recovery from adaptation differs across visual areas for stimulus transitions that cross the categorical boundary compared to those that do not.

THINKING: Reasoning

G102

GIST-REASONING: AN INDEX OF FLUID INTELLIGENCE IN ADULTS WITH TRAUMATIC BRAIN INJURY Asha Vas[1], LayVette Johnson[2], Sandi Chapman[3]; [1]Center for BrainHealth, University of Texas at Dallas — The fluid thinking ability to synthesize and abstract meanings from large amounts of information referred to as gist-reasoning, is essential for daily-functioning. Researchers postulate fluid and flexible thinking abilities to be suggestive of frontal-lobe integrity. Previous evidence found that a traumatic brain injury (TBI) during the preteen-teenage years (i.e., during the critical frontal-network myelination period) can lead to gist-reasoning impairments. The current study expands on this evidence to examine the effects of adulthood TBI on gist-reasoning. Gist-reasoning was examined on synthesized meanings conveyed from three complex texts that varied in length and complexity. Additionally, we examined the contribution of cognitive processes of (a) inhibition, (b) working memory, (c) switching, and (d) immediate memory to gist-reasoning. Forty healthy adults and 40 adults with TBI in chronic-stages of recovery, all between the ages of 25-55 years at testing, age and socio-economic status matched, were included in the study. Results indicated decreased gist-reasoning in adults with TBI as compared to their healthy peers. Additionally, the contribution of the core frontal-lobe processes of inhibition, working memory, and switching to gist-reasoning was over and above immediate memory for the explicitly stated facts of the three texts. This study introduces a novel index of fluid intelligence abilities of a functionally-relevant task and provides evidence of the vulnerability of higher-order cognition of complex information processing. Furthermore, the significant contribution of the three frontal-processes supports existing evidence of their role as 'core subcomponent-processes' for performing complex fluid-intelligence tasks. The potential implications for cognitive rehabilitation methodologies are discussed.

G103

DEDUCTIVE REASONING NETWORKS: A META-ANALYSIS OF THE NEUROIMAGING DATA Sabrina Lemire-Rodger[1], Ashley M Bondad[1], Bradley R Buchsbaum[2]; [1]Rotman Research Institute, [2]University of Toronto — There are two dominant theories in the reasoning literature. The Mental Models Theory (MMT) states that we reason by creating spatial representations of problems. The Mental Logic Theory (MLT) holds that reasoning is rule-based, operating on abstract symbolic mental representations. Functional neuroimaging studies have supported both theories, with parietal activation offered as evidence for MMT and temporal lobe activation favoring MLT. Unfortunately, the findings have been inconsistent. This may be because while there are different types of deduction, only a few studies have directly evaluated how they differ in terms of their neural substrates. In this study, we catalogued the different types of deductive reasoning tasks that have been used in neuroimaging studies, and considered additional factors that may modulate neural activation. We reviewed 27 neuroimaging experiments on deductive reasoning and used ALE (Activation Likelihood Estimation) meta-analyses to examine cross-study consistency in brain activation patterns. Overall, we found that deduction was associated with a mostly left-hemisphere fronto-parietal activation network. However, we found that different classes of reasoning tasks elicited markedly different patterns of activation. Conditional deduction activated a parietal-prefrontal network, while categorical deduction was associated with a temporal lobe-ventral prefrontal network. Relational deduction was the only type of reasoning that gave rise to bilateral frontal lobe activation. We also discovered that the task content, whether concrete or abstract, had an effect on which reasoning network was recruited. These findings encourage us to view deduction as a set of processes recruiting partially dissociable brain networks.

G104

RELIGIOUS BELIEF SYSTEMS OF PERSONS WITH HIGH FUNCTIONING AUTISM Caitlin Murphy[1], Tessa Velazquez[2], Catherine Caldwell-Harris[3], Patrick McNamara; [1]Boston University, [2]Boston University, [3]Boston University, PhD, [4]Boston University, PhD — The cognitive science of religion is a new field which explains religious belief as emerging from normal cognitive processes such as inferring others' mental states, and agency detection. Our research is comprised of three studies which investigate the proposal that individual differences in belief will reflect cognitive processing styles, with high functioning autism (HFA) being an extreme style that will predispose towards non-belief (atheism and agnosticism). In study 1, 192 unique posters on an autism website were analyzed for religious beliefs and for the expression of thinking traits indicative of HFA cognitive styles. In study 2, an online survey examining religious belief and cognitive styles was administered to 61 individuals who identified as HFA. The results of studies 1 and 2 revealed that persons with ASD were more likely than those in our neurotypical comparison group to identify with non-belief categories, and, if religious, were more likely to construct their own religious belief system. In study 2, quantitative analyses revealed significant differences between religious categories with members of non-belief categories scoring higher on the Autism Quotient as well as the Systemizing Quotient. Study 3 is currently in progress and entails a series of empirical tasks preformed by participants ranging from neurotypical to HFA. The tasks included measure social attribution, intentionality, global/local processing bias, and the survey administered in study 2. Preliminary findings of this study are consistent with those of studies 1 and 2 but additionally indicate a relationship between local/global processing bias and religious belief.

G105

NEURAL CORRELATES OF HIGH MATHEMATICAL ABILITY: A VOXEL BASED MORPHOMETRY STUDY Sephira Ryman[1], Ranee A. Flores[1], Joe A. Frantz[2], Rex E. Jung[1]; [1]University of New Mexico Health Sciences Center-I Department of Neurosurgery, [2]Mind Research Network — Neuroimaging studies of mathematical abilities are largely devoted to investigations of dyscalculia, a disorder that includes deficits in mathematical abilities (Rotzer et al., 2008; Rykhlevskaia et al., 2009), or functional studies of mathematical computation tasks (Davis et al., 2009). This study sought to explore structural correlates of high math ability. Previous research has demonstrated rather discrete regions of activation during functional imaging tasks associated with math processing, specifically the intraparietal sulcus (IPS) and the superior parietal lobule (SPL)(Ansari, 2008). We hypothesized that individuals with high math abilities would have increased grey matter in the parietal lobe, corresponding with regions demonstrated to be active during functional imaging experiments. We utilized optimized Voxel-based morpohometry (VBM) (Good et al., 2001) to compare high math individuals (N=23) to normal healthy controls (N=23) matched on age, sex, and full scale intelligence quotient (FSIQ). High math ability was determined by performance (>95th %ile) on the GRE, ACT, or SAT while FSIQ was assessed by the Wechsler Abbreviated Scale of Intelligence (WASI). A two-sample t-test of an ROI limited to the parietal lobe was conducted using SPM5 using total grey matter as a covariate. Multiple areas demonstrated significant increased grey matter ($p<.001$) in individuals with high mathematical abilities, the largest clusters located in the left IPS and the left SPL. Significant grey matter increases were also seen within the homologous left parietal lobe, with smaller clusters observed. These findings support results from numerous functional studies that implicate the IPS and SPL in mathematical abilities.

G106

EXPLORING THE FUNDAMENTAL COGNITIVE COMPONENTS OF HUMAN REASONING Ehsan Shokri Kojori[1], Penelope Jones[1], Srikant Chari[1], Michael Motes[1,2], Daniel Krawczyk[1,2]; [1]The University of Texas at Dallas, [2]The University of Texas Southwestern Medical Center — Reasoning has been of historical interest as one of the most prominent aspects of human cognition. Generally, reasoning can be viewed as the ability to make logical inferences from the surrounding world in novel circumstances (fluid reasoning) or conditions that resemble past experiences (crystallized reasoning). Intelligence scores are heavily affected by reasoning abilities and many standardized tests have been specifically developed to assess individual differences in reasoning abilities. This work is a novel attempt to provide a partialized realization of fundamental cognitive components contributing to various aspects of reasoning performance. A task was designed with three conditions examining Visual Search (VS), Rule Verification (RV) and Rule Generation (RG) processes. Task conditions consisted of 48 trials of visuospatial problems, each with three panels containing 4 geometrical shapes. In VS, participants searched for a shape-change across the panels. In RV, participants verified whether a shape-change followed one of four learned rules. In RG, participants inferred whether a shape-change followed a novel logical rule. Our results indicate that the systematic increase in contributing cognitive components between VS, RV, and RG resulted in consistent decline in performance measured by reaction-time and accuracy. Further, performance on a standard set of reasoning problems (Raven's Advanced Progressive Matrices) was predicted differentially by the task conditions. Raven's reaction-time was best predicted by RV followed by RG reaction-times. Raven's accuracy, however, was predicted by accuracy in RG and VS conditions. Finally, these findings provide insight into a subset of cognitive components accounting for differences in reasoning abilities.

G107

RELATIONAL COMPLEXITY AND RELATIONAL DISTRACTION MODULATE RESPONSE-LOCKED EVENT-RELATED POTENTIALS IN ANALOGICAL REASONING Brian M Sweis[1], Krishna L Bharani[1], Robert G Morrison[1]; [1]Loyola University Chicago — Numerous studies have shown that relational complexity and distracting featural or relational information increase the difficulty of analogical reasoning. Both factors interact with age in both the young and old and in patients with damage to prefrontal cortex (PFC). In addition, several functional magnetic resonance imaging (fMRI) studies have suggested that more anterior regions (e.g., frontopolar) of PFC become increasingly active as the relational complexity of analogy problems increases. Likewise, slightly more posterior regions of PFC become increasingly active in the face of distraction by goal-irrelevant relational information. Some behavioral results have suggested that these two factors are additive, with goal-irrelevant relational information having a greater effect on more relationally complex problems, but little is known about the time-course of processing complex relational reasoning problems. In this study, we use scalp electroencephalography (EEG) to monitor brain potentials during performance of geometric analogy problems that vary with respect to both factors. Behaviorally, accuracy decreases and RT increases as relational complexity increases and with the presence of relationally distracting information. In addition, relational complexity and relational distraction interact, with distraction having a larger impact on more relationally complex problems. In a prior visual analogy study, we identified a response-locked event-related potential (ERP) in left prefrontal electrodes that predicted successful analogical mapping when measured late in analogy processing. In the present study, we show that this ERP is modulated by both relational complexity and relational distraction. The present results provide additional support for this ERP as a neural metric of analogical processing.

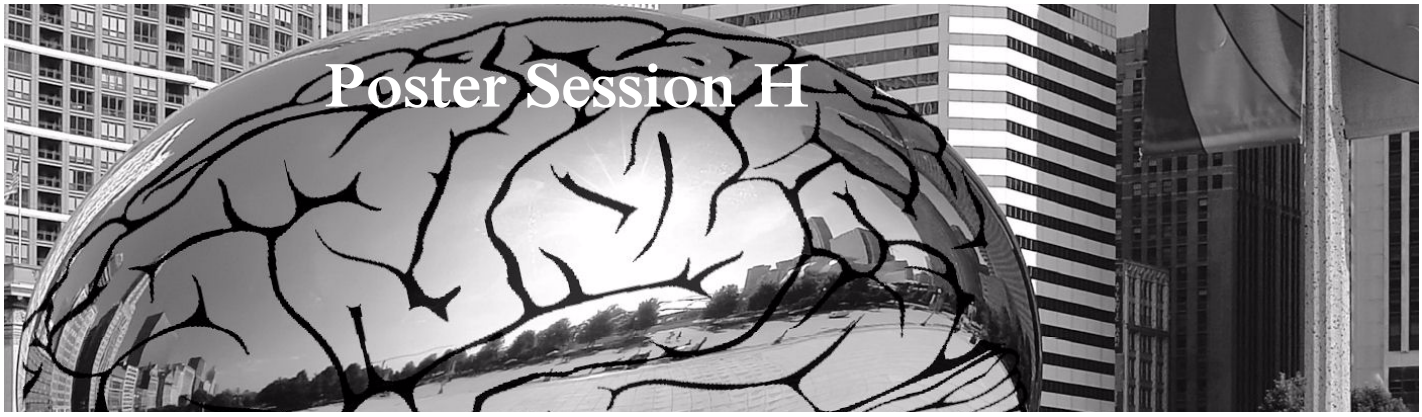
G108

WHEN ANALOGY IS LIKE PRIMING: THE N400 IN VERBAL ANALOGICAL REASONING Robert G Morrison[1], Matthew J Kmiecik[1], Krishna L Bharani[1]; [1]Loyola University Chicago — Computational models of analogy have frequently relied on explicit relational representations and mechanisms for structured mapping. This approach predicts engagement of the working-memory system directed by the prefrontal cortex (PFC), a prediction generally consistent with patient and neuroimaging studies. More recently, several connectionist models based on the phenomenon of analogical priming have attempted to provide an alternative explanation for 4-term verbal analogies. These models rely on forms of spreading activation and would predict activation more like semantic priming during verbal analogy solving. To test this claim we recorded scalp electroencephalography during a verbal analogy task. In this paradigm, participants initially retrieved the relationship between a first word pair and then received a cue instructing them to either judge a second pair of words for relatedness (semantic only) or alternatively decide whether they formed a valid analogy (analogy) with the first pair. Bunge et al. (2005) previously found that the analogy condition activates left rostrolateral PFC compared to the semantic only condition. In our study we found that event-related potentials (ERPs) of analogy and semantic only trials diverged at the N400 with semantic only trials giving the more negative N400. The amplitude of the analogy N400 predicted participant performance. These results differ from previous studies of visual analogy that have shown only a late response-locked ERP predicting analogical mapping performance. Taken together these results suggest that under some conditions solving verbal analogies may use a mechanism similar to priming rather than that of analogical mapping.

G109

PARADOXICAL INFLUENCE OF WORKING MEMORY ON BUILDING AND UPDATING MENTAL MODELS Derick Valadao[1], Britt Anderson[1,2], James Danckert[1]; [1]Department of Psychology - University of Waterloo, [2]Centre for Theoretical Neuroscience - University of Waterloo — The ability for humans to build mental models is critical for goal setting, decision making, and

predicting environmental contingencies. As we engage with our environment, we form mental models by continuously sampling information and matching it with our model. Mental models also must be updated. That is, as the environment changes, we should update our internal representations to effectively act on, and engage with, our environment. The current study aimed to elucidate how individuals form and update mental models of their environment. Further, working memory (WM) represents a key component of mental model building. Here we tried to determine the influence of WM on forming and updating mental models. Participants completed a spatial prediction task, in which they were asked to predict the location of sequential targets. Unbeknownst to the participants, target locations were drawn from normal distributions that were altered every 20 trials. Simultaneously, participants completed a WM task in which they determined whether the current object contained a target feature (0-back) or matched a feature of the object two trials back (2-back) along three dimensions (location, shape, and colour). It was expected that maintaining locations in WM would aid in mental model building. Participants effectively formed and updated representations of target locations. Contrary to our expectations, spatial WM (2-back) significantly impaired the ability to form mental representations of target location relative to shape/colour WM. These results suggest that the highly specific demands of WM tasks interfere with our capacity to develop and update mental models of spatial distributions.



Tuesday, April 3, 8:00 - 10:00 am, Exhibit Hall

EMOTION & SOCIAL: Emotion-cognition interactions

H1

SEPARATE NEURAL SYSTEMS RESOLVE EMOTIONAL AND NONEMOTIONAL CONFLICT IN CHILDREN Kayla Martin[1,2], Stephen Shen[3], Moriah E. Thomason[2,4]; [1]Department of Psychology, Wayne State University, [2]Merrill Palmer Skillman Institute, [3]Basic Medical Sciences, Wayne State University School of Medicine, [4]Department of Pediatrics, Wayne State University School of Medicine — It has been shown that cognitive control, the ability to override competing thoughts and actions in favor of goal directed behavior, is imperative to a child's ability to resist cognitive interference and foundational to cognitive development. Prior work in adults has shown separable neural systems underlie management of emotional versus non-emotional conflict, but little is known about the independent or overlapping behavioral and neural systems that support the development of different forms of cognitive control in children. Here, we performed two Stroop-like conflict tasks (emotion and non-emotion gender) while children ages 9-13 underwent fMRI scanning. In the emotion task, participants identified the expression of a fearful or happy face while ignoring an overlying emotion word ("fear" or "happy"), which either matched (congruent; C) or conflicted (incongruent; I) with the facial expression. The highly analogous non-emotion task required that participants identify the gender of the male or female face while ignoring an overlying gender word ("male" or "female"). Preliminary analyses of behavioral and neural data has revealed incongruent stimuli results in reaction time (RT) interference (RT for I>C) across material-types, that the effect of adaptation (faster RTs on sequential incongruent trials) was stronger for gender non-emotion trials than emotion trials, and that activity in separate neural regions (rostral anterior cingulate (rACC) and lateral frontal) is associated with emotional versus non-emotional conflict resolution. Thus, our analyses support dissociation of these systems in youth at both the behavioral and neural level. Additionally, our data suggests these systems may follow different maturational timelines.

H2

THE COST OF COMPARISON: NORMATIVE ACHIEVEMENT GOALS MATTER MORE THAN GENDER IN DETERMINING REBOUND FROM FAILURE IN MATH Jennifer Mangels[1], Laura Deering[1], Catherine Good[1]; [1]Baruch College, City University of New York — Achievement in STEM disciplines is not determined by ability alone, but also by social and motivational factors. Recently, there has been considerable focus on the role stereotypes play in handicapping females' ability to optimally utilize cognitive resources for math problem solving. Although environments that neutralize stereotype threat should theoretically eliminate gender differences, if females hold achievement goals that emphasize comparison of one's ability to others (normative goals), they may still experience differentially poor outcomes when they perceive that their ability is lacking. In contrast, achievement goals focusing on challenge and mastery are likely to be associated with persistence and rebound after failure, regardless of gender. In the present study, males and females who primarily identified with either normative (N-bias) or challenge goals (C-bias) participated in a difficult test-feedback-retest math paradigm under non-threat framing. We focused our analysis on event-related potentials (ERPs) to negative accuracy feedback following first-test errors, subsequent engagement with a computerized tutor, and the extent to which this engagement predicted error correction on a surprise retest (i.e., learning). Gender had no effect on either first test performance or learning from the tutor, although females exhibited an enhanced FRN to negative feedback and greater investigation of the tutor. Goals, however, did influence learning. N-biased students fared more poorly at retest than C-biased students. This poorer rebound from failure was coupled with an enhanced frontal P3 and late positive potential (LPP) to negative feedback, suggesting that heightened attention to failure signals can interfere with successful learning, regardless of gender.

H3

PARAMETRIC DEPICTION OF EARLY AND LATE ANALYSIS OF FEAR IN VARIOUS INTENSITIES: AN ERP STUDY Emily Forscher[1], David Rozek[2], Wen Li[1]; [1]University of Wisconsin-Madison, [2]University of Notre Dame — In real life, we experience threat in differing intensities, ranging from a mild threat of confronting an unfriendly face to the extreme threat of facing death. However, a systemic investigation of human responses to varying levels of threat and their underlying neural mechanisms has not yet been performed. Here, combining morphing techniques and brain electrophysiology, we varied the percentage of fear information morphed into a neutral face from 2% to 45% (in increments of 6%) to parametrically delineate early and late analysis of threatening facial emotions, and to associate threat processing with individual affective states. Participants' fear detection rates across the levels conformed closely to a sigmoid function, and the inflection point (i.e., fear detection threshold) correlated positively with positive affect: increased positive affect reduced sensitivity to fear. Based on the detection threshold, N170 (at P7) revealed differential response to sub- and supra-threshold fearful faces ($t = 2.15$, $p = 0.05$). Late positive potentials (500-600 ms) at Pz exhibited a significant linear trend ($t = 3.12$, $p = 0.01$), increasing in amplitude with incremental fear intensity. Therefore, early visual responses largely classified these stimuli dichotically into "fear" or "no fear" categories, while later visual analysis appeared to perform a parametric profiling of the amount of fear in the face. These patterns conform to the well-established theories of early "quick-and-dirty" processing and later elaborate analyses of emotion.

H4

STOP FLIPPING THE SWITCH: STRESS MODULATES THE USE OF BASAL GANGLIA- AND HIPPOCAMPUS-MEDIATED LEARNING STRATEGIES IN SUBCLINICAL OBSESSIVE-COMPULSIVE DISORDER Winifred Limmer[1,2], Valerie Voon[1,2], Christian Doeller[3], Mark Gluck[4], Catherine Myers[5,6,7], Barbara Sahakian[1,2]; [1]University of Cambridge, [2]MRC/Wellcome Trust Behavioural and Clinical Neuroscience Institute, [3]Donders Institute for

Brain, Cognition, and Behaviour, Radboud University Nijmegen, The Netherlands, [4]Center for Molecular and Behavioral Neuroscience, Rutgers University, Newark, NJ, [5]New Jersey Health Care Center, East Orange, NJ, [6]Stress & Motivated Behavior Institute, New Jersey Medical School, Newark, NJ, [7]Rutgers University, Newark, NJ — Schwabe and colleagues (2007) proposed that stress functions as a "switch" between the basal ganglia (BG) and hippocampal (HC) memory systems. They observed enhanced BG-mediated "habit" learning at the expense of HC-mediated "cognitive" learning in animals and humans resulting from acute, as well as chronic, stress. This theory may be a useful model of obsessive-compulsive disorder (OCD) and its subclinical form (OCS). Several recent studies have documented BG hyperactivity, of which compulsions may be a behavioural manifestation, in individuals with OCD. Impaired HC functioning has also been documented, though inconsistently. We propose that Schwabe's theory accounts for these seemingly unrelated findings. We furthermore propose that there are several acute and chronic stress-related features of OCD/OCS that may "flip the switch" between the BG and HC memory systems (e.g. hyperactivity of the hypothalamic-pituitary-adrenal axis). In the present study, acute stress was induced with the socially evaluated cold-pressor test and assessed via salivary cortisol; chronic stress was assessed via questionnaire. Then, a probabilistic reversal task and an object-location memory task, both of which can be performed using either a HC or BG learning strategy, were administered to individuals with and without OCS. Preliminary results indicate impaired hippocampal functioning and increased use of BG strategies in individuals with OCS – effects that were exacerbated by acute stress. These results suggest that stress interacts with obsessive-compulsive symptomology to enhance BG functioning at the direct expense of HC functioning.

H5

EXAMINING THE EFFECT OF AROUSAL, VALENCE, AND DISTINCTIVENESS UPON MEMORY TRADE-OFFS Carolina Campanella[1], Stephan Hamann[1]; [1]Emory University, Atlanta GA — Memory for emotionally salient or central stimuli in emotional scenes is frequently enhanced at the expense of background, peripheral information. This phenomenon, known as the emotional memory trade-off effect, has been used widely as a paradigm for examining how emotion biases memory encoding processes. A leading account of this trade-off effect is that it results from attentional capture by central emotional components, leaving reduced attentional resources available to encode background information. However, other non-affective factors such as distinctiveness may also capture attention and induce a memory trade-off, though these factors have received relatively little attention. We examined the roles of emotional arousal, valence, and distinctiveness in the memory trade-off effect for complex scenes. During encoding, participants viewed scenes consisting of a central object (either negative, positive, neutral, or visually distinctive but emotionally neutral) against neutral backgrounds. Eye-tracking data was collected to assess attention at encoding. After a 24-hour delay, participants returned for an unannounced recognition test. Participants fixated more on emotional and distinctive objects than neutral objects, and fixations to the scene backgrounds was correspondingly decreased for emotional and distinctive objects. As predicted, a recognition memory trade-off occurred for both distinctive objects and emotional objects, relative to neutral objects, and this trade-off was most marked for high-confidence recognition judgments. Our findings suggest that both distinctiveness and emotional characteristics can induce a memory trade-off effect, and point to the importance of separately assessing the contributions of both factors when examining cognitive and neural mechanisms underlying the memory trade-off effect.

H6

ANTERIOR CINGULATE CORTEX GRAY MATTER VOLUME CORRELATES WITH NONCONSCIOUS ATTENTION BIAS TO THREAT Joshua Carlson[1], Felix Beacher[1], Karen Reinke[2], Reza Habib[3], Eddie Harmon-Jones[4], Greg Hajcak[1]; [1]Stony Brook University, [2]University of Illinois Springfield, [3]Southern Illinois University Carbondale, [4]Texas A&M — The allocation of spatial attention towards threatening stimuli is an important aspect of the fear response, which can occur automatically without conscious awareness. Functional neuroimaging research has linked this behavior to a network comprised of the amygdala, anterior cingulate cortex (ACC), and visual cortex. Currently, it is unclear how variability in underlying brain morphometry may relate to individual differences in attention bias to threat. We performed two experiments collecting whole-brain structural magnetic resonance images and dot-probe data measuring individuals' attention bias to backward masked fearful faces. Voxel-based morphometry was used to assess gray matter volume. We hypothesized that reduced gray matter within the amygdala and ACC would be associated with reduced attention bias to threat. In Experiment 1 (N=42), we found that backward masked fearful faces captured spatial attention and that larger ACC gray matter volumes were associated with greater nonconscious attention bias to fearful faces. In Experiment 2 (N=12), we replicated this association in an independent sample. In sum, we provide both initial and replicating evidence that ACC gray matter volume is correlated with biased attention to nonconscious threat. We demonstrate for the first time that variability in affective attention bias is associated with ACC morphometry. Given that elevated attention bias to threat is associated with anxiety, future research needs to explore the underlying brain morphometry associated with attention bias in anxious populations.

H7

VALENCE EVALUATIONS OVERRIDE INNATE SALIENCE OF HIGH-AROUSAL WORDS: THE LATE POSITIVITY AS A DYNAMIC MEASURE OF EMOTIONAL RELEVANCE Nathaniel Delaney-Busch[1], Gianna Wilkie[1], Ju Hyung Kim[1], Ann Yacoubian[1], Gina Kuperberg[1,2]; [1]Tufts University, [2]Martinos Center for Biomedical Imaging, Mass General Hospital — We used event-related potentials to investigate the processing of pleasant, unpleasant, and neutral words that were either high or low in arousal. In a previous study, we demonstrated that when emotion is not task relevant, a late positive component (thought to reflect sustained evaluations of emotional stimuli) is modulated by arousal, but not by valence: its amplitude was larger to high than low arousal words, regardless of whether they were pleasant, unpleasant, or neutral. But when arousal was matched, its amplitude was the same across the three valence conditions. These findings suggest that, when emotion was irrelevant, sustained evaluations were triggered by the inherent arousing properties of the words, rather than their emotional valence. We asked whether this was also true when participants overtly attended to valence. We presented the same 468 single words to 22 new participants as they rated each word as pleasant, unpleasant, or neutral. Word groups were carefully matched on concreteness, frequency, word length, and other lexical properties. In contrast to the previous study, the late positivity showed no difference between the high and low arousal words. Instead, it showed a robust effect of valence, with pleasant and unpleasant words eliciting a larger positivity than the neutral words. Taken together, our two studies demonstrate that the late positivity is a dynamic indicator of immediate emotional relevance, and is not directly connected to either valence or arousal.

H8

THE SPEED OF MORAL SENSITIVITY Jean Decety[1], Stephanie Ortigue[2,3]; [1]The University of Chicago, [2]University of Geneva, [3]Syracuse University — People's capacity to recognize a behavior as intentional is a central component of human social cognition. This capacity plays a crucial role in moral judgment. To characterize real time neural processing underpinning moral computations, high-density event-related potentials were measured in participants while they perceived short visual scenarios depicting intentional and accidental harm done to others. Brain microstate analysis revealed a total of six time periods of stability that significantly differed both in timing and location for intentional harm and accidental harm. The former was significantly distinguished from

the latter over two main time periods i.e., from 62 to 120 ms, and from 122 to 180 ms post-stimulus. More precisely, a specific scalp potential field with a current source density maximum in the right posterior superior and medial temporal gyri characterized accidental harm during the first time period; whereas a different scalp topography with a current source density in the right amygdala characterized intentional harm. The fast involvement of these brain regions in differentiating intentional from accidental harm demonstrates that automatic perception of intentionality is a critical input to the perception of moral valence of an action, and seems to precede emotional processes. This study is the first to determine the spatio-temporal dynamic of the neuro-computational processes underlying moral cognition.

H9

EMOTION AND ATTENTION IN CORTICAL RESPONSES TO WRITTEN WORDS Mareike Bayer[1], Werner Sommer[1], Annekathrin Schacht[2]; [1]Humboldt-Universität zu Berlin, [2]University of Göttingen — For emotional pictures with fear-, disgust- or sex-related contents, stimulus size has been shown to potentiate emotion effects in event-related potentials (ERPs), presumably reflecting the enhanced biological impact of larger emotion-inducing pictures. If this is true, size should not enhance emotion effects for written words with symbolic and acquired meaning. Here, we investigated the effect of font size for emotional and neutral words. Emotion effects in ERPs started earlier, were stronger and lasted longer for large relative to small words. These results suggest that emotion-driven facilitation of attention is not necessarily based on biological relevance, but might generalize to stimuli with arbitrary perceptual features. This finding points to the high relevance of written language in today's society as an important source of emotional meaning.

H10

LANGUAGE SHAPES PERCEPTION OF EMOTION: A CASE STUDY OF SEMANTIC DEMENTIA Maria Gendron[1,4], Kristen A. Lindquist[2,3], Lisa Feldman Barrett[2,4], Bradford C. Dickerson[2]; [1]Boston College, [2]Harvard Medical School, Massachusetts General Hospital, Martinos Center for Biomedical Imaging, [3]Harvard University, [4]Northeastern University — It is assumed that emotions are encoded in the face, and that the ability to perceive emotions is inborn, universal, and fundamental. Language is not usually considered to play an important role in emotion perception. We report findings from two patients with semantic dementia that cannot be explained by this "basic emotion" view. These patients, who have substantial deficits in semantic processing abilities following neurodegeneration to the left anterior temporal lobe, were asked to sort a set of scowling, wide-eyed, wrinkle-nosed, frowning, smiling and neutral faces into as many categories as they perceived in the set. Patients could perceive positive or negative feelings in faces but could not perceive discrete emotions like anger, disgust, fear, or sadness, as indicated their piles. Our findings support the alternative hypothesis that emotion words are necessary to transform perceptions of affect (positive/negative feelings) into perceptions of discrete emotion. These findings have important consequences for the science of emotion and interpersonal communication in the global community.

EXECUTIVE PROCESSES: Monitoring & inhibitory control

H11

THE ROLE OF STOP-SIGNAL PROBABILITY AND MOTIVATION IN A STOP-SIGNAL TASK Hsin-Ju Lee[1], Wen-Jui Kuo[1]; [1]Institute of Neuroscience, National Yang-Ming University — In the stop-signal paradigm, previous studies indicated that the latency for processing inhibition signal remains stable, suggesting its independency to the context. In this study, two experiments were conducted to examine two factors for the control of response inhibition, i.e., appearance of stop-signal frequency and motivation (to stop). In Experiment 1, probabilities of stop-signal occurrences were varied in a small range (20%, 30%, and 40%). The go-RTs under the three probabilities differ significantly, indicating that subject's attention was modulated. However, the estimated RTs for processing the stoop-signal were not changed, suggesting the robustness of its independence. The ERP data showed differential P300 effects for the successful-stopping trials (SSTs) and fail-to-stop trials (USSTs). The SSTs elicited a fronto-central P300 (electrode Fz & Cz) effect whereas the USSTs evoked a centro-parietal P300 (electrode Pz) effect. The effect of the USSTs peaked later than that in the SSTs. Moreover, we found an N2-like component occurring only in the USST difference waveform, which behaved more actively in the 20% condition. In the second experiment we included money reward to promote motivation of the subjects for both speeding up the response of the go trials and trying to stop as accurate as possible for every stop-signal. While the go-RT is faster in rewarding condition, there was no difference for the SSRT between the neutral and rewarding condition. The ERP results show obvious N2 effect in USSTs for the rewarding context.

H12

MEASURING INDIVIDUAL COMPONENTS OF EXECUTIVE PROCESSING: EVIDENCE FROM DIVERGENT INTERFERENCE EFFECTS IN THE SIMON TASK, THE FLANKER TASK, AND THE SWITCHING TASK Oliver Sawi[1], Zack Greenberg[1], Kenneth Paap[1]; [1]San Francisco State University — In recent years, researchers have used the Simon, flanker, switching, and other tasks to measure various components of central executive processing. Previous research has reported that executive processing ability is positively associated with bilingualism and computer gaming. In the current study, 106 participants completed the Simon (yielding a measure of inhibitory control), flanker (yielding a measure of inhibitory control), and switching (yielding measures of both conflict monitoring and switching). The participants also completed the Raven's Test of nonverbal reasoning and a demographic survey containing questions regarding language proficiency, multitasking, video game play, and team sports play. The results yielded highly significant Simon effects, flanker effects, switching costs, and mixing costs. Stepwise regression analysis showed that the magnitude of the Simon effect was inversely related to the participant's Raven's score and the amount of time spent listening to music while doing homework. The magnitude of flanker interference was directly related to the participant's multilingualism score and inversely related to team sports ability. Contrary to previous reports, the former suggests a bilingual disadvantage in executive control of attention. Each of these tasks have been purported to measure executive processing ability. However, the correlations between the magnitudes of these effects are near zero and this holds even for the Simon and flanker effect that are assumed to measure the same executive process (viz., inhibitory control). The absence of significant correlations between tasks questions their use as indices of executive processing in investigations of special populations such as ADD, dementia, or bilingualism.

H13

BRAIN ACTIVITY RELATED TO CONFLICT PROCESSING VANISHES IN CHILDREN WITH OCD AND HEALTHY CONTROLS AFTER CONTROLLING FOR THE RT-BOLD RELATIONSHIP. Kamin Kim[1], Joshua Carp[1], Kate Fitzgerald[1], Stephan Taylor[1], Daniel Weissman[1]; [1]University of Michigan — The posterior medial prefrontal cortex (pMFC) is thought to participate in detecting conflict between competing responses. Consistent with this view, pMFC activity in fMRI studies is greater in incongruent than in congruent trials of Stroop-like tasks. However, within each of these trial types, the event-related BOLD signal in adults increases linearly with reaction time (RT). Moreover, conflict-related pMFC activity vanishes after controlling for this "RT-BOLD relationship." Thus, conflict-related pMFC activity could potentially reflect any process whose recruitment increases with time on task (e.g., sustained attention). Here, we investigated whether this same ambiguity in interpreting pMFC activity is present in children. Although a recent study from our laboratory reported that children did not exhibit a RT-BOLD relationship in the pMFC, brain activity is often more variable in children than in adults. We therefore sought to maximize statistical power in the present study

by testing a larger sample of children. Participants (35 Obsessive Compulsive Disorder [OCD] and 29 healthy pediatric controls), performed the multi-source interference task while their brain activity was recorded with fMRI. To control for the RT-BOLD relationship in each participant, we contrasted activity in RT-matched congruent and incongruent trials. In both children with OCD and healthy controls, we observed a neural congruency effect and a linear RT-BOLD relationship in the pMFC. Moreover, the effect of congruency on pMFC activity vanished after controlling for this linear relationship. We conclude that, as in adults, conflict-related pMFC activity in children could potentially index any process whose recruitment increases with time on task.

H14

THE NEUROANATOMY OF ACTION CONTROL: PARSING THE ROLES OF THREE BRAIN REGIONS IN PROCESSING ERRORS OF CHOICE AND ERRORS OF MOVEMENT EXTENT. eldad hochman[1], Seqian Wang[1], Theodore Milner[1], Lesley Fellows[1]; [1]McGill university — We sought to delineate the necessary roles of three brain regions in action control, by studying the effects of damage to those regions in humans. Five subjects with damage to right inferior frontal gyrus (rIFG), three with basal ganglia (BG) damage, and five with damage to the dorsomedial prefrontal cortex (DMF) were compared to 8 healthy subjects on a modified flanker task requiring either small or large extent wrist movements to the left or right. The kinematics of correct, erroneous and corrective responses were recorded with high temporal resolution. Choice error detection was indexed by a novel RT measure, based on the hypothesis that more rapid error detection reflects greater error-correct response mismatch: All subjects except those with BG damage exhibited the predicted direct correlation between error RT and error stop, consistent with intact error detection. The BG patients showed the opposite pattern, suggesting that they required a larger degree of error-correct mismatch to detect errors. For extent errors, again all patients except those with BG damage exhibited a direct correlation between the size of the extent error and the time between error stop and correction onset. Thus, the BG but not frontal regions seem critical for both choice and extent error detection. We examined error inhibition by measuring error acceleration and deceleration, finding that BG damage affected both, while DMF damage slowed only deceleration. Those with DMF damage were also slower to correct choice, but not extent errors. RIFG damage did not affect any aspect of error processing.

H15

A GRATTON EFFECT IN THE ABSENCE OF AWARENESS OF CONFLICT: EVIDENCE FOR IMPLICIT PERFORMANCE MONITORING Chris Blais[1], George R. Mangun[1]; [1]University of California, Davis — The conflict-monitoring hypothesis states that the Gratton effect occurs because conflict from an incongruent trial signals the anterior cingulate to recruit executive processes residing in the dorsolateral prefrontal cortex to optimize performance. Electrophysiological studies assume that the N2 component located over central electrode sites indexes this conflict. An important theoretical question concerns whether the Gratton effect occurs because of increased attention to the relevant dimension or decreased attention to the irrelevant dimension (or both). At a conceptual level, it is difficult to envision how the system could adjust attention to an unperceived feature. Thus, we measured the Gratton effect when subjects were rendered unaware of the irrelevant dimension. ERPs were recorded to look at the N2 component while subjects viewed a task-irrelevant array of randomly moving dots. The dots primed a left or right response because we manipulated the proportion of the dots (i.e., coherence) moving in the same direction. In the aware condition, coherence was 95%. In the the unaware condition, coherence was set individually for each subject. The task was to make a left or right key press when the moving dots changed in color from white to yellow or red. A Gratton effect was observed both when subjects were aware, and unaware, of the direction of motion. Since subjects are unaware of the irrelevant dimension, the Gratton effect must be the result of subjects increasing attention to the relevant dimension. We discuss implications for the conflict monitoring hypothesis and the allocation of attention in general.

H16

THE MODULATION OF ERROR PROCESSING BY EXPERIMENTALLY INDUCED NEUROPLASTICITY WITH TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS) Martin Herrmann[1], Lisa Bellaïche[1]; [1]University of Wuerzburg — We constantly controlling the outcome of our actions in order to detect a possible discrepancy between the expected outcome and the real outcome of our actions. This process of action, or error monitoring allows us to adjust our behavior in order to correct present action or to prevent future errors. The underlying neurophysiologic correlates of error monitoring can be studied with event-related potentials (ERPs, the so called error-related negativity (ERN) and error positivity (Pe), Falkenstein et al., 2001). As altered error monitoring has been described in patients with psychiatric disorders, the use of brain stimulation techniques, like transcranial direct current stimuation (tDCS) might be an interesting approach for future therapeutic strategies. The aim of our study was therefore to investigate whether tDCS is suitable to modulate brain activity related to error monitoring. In our study 48 heathy controls were randomly assigned to three groups, anodal, cathodal or sham stimualtion over the medial prefrontal cortex during execution of an eriskon-flanker task and during simultaneously recording the ERN and PE. We found that cathodal stimulation attenuates the Pe between 200 and 300 ms compared to sham and anondal stimulation. In contrast the ERN was not modulated. We conclude that tDCS can decrease the more concious part of error monitoring processes and might be a considered as a therapeutic tool for anxiety disorder patients to decrease the sensitivity of their error monitoring system.

H17

NAVIGATIONAL STYLE AND ELECTROPHYSIOLOGICAL CORRELATES OF CONFLICT IN AN AUDITORY SPATIAL STROOP TASK George Buzzell[1], Carryl Baldwin[1], Daniel Roberts[1], Jane Barrow[1], Craig McDonald[1]; [1]George Mason University — Research has shown that individuals differ in the strategy they use to navigate through the world. Some use a predominantly verbal-egocentric strategy while others rely more heavily on a spatial-allocentric strategy. Navigational strategy, assessed by a way-finding questionnaire, is predictive of performance on an auditory spatial Stroop task, in which either the semantic or spatial dimension of stimuli must be ignored. Verbal navigators are significantly slower to respond when attempting to ignore task-irrelevant semantic information, whereas the opposite pattern is observed for spatial navigators (with increased interference observed when attempting to ignore task-irrelevant spatial information). To explore the time course of conflict processing--and how it differs between verbal and spatial navigators--participants performed an auditory spatial Stroop task while event-related potential (ERP) data were collected. Participants were required to respond to either the semantic meaning or the spatial location of directional words, played from either congruent or incongruent spatial locations. In the Semantic task participants responded to the semantic meaning of the word (i.e., "Left" or "Right") and attempted to ignore task-irrelevant spatial information. In the Location task participants responded to the spatial location of the stimuli, while attempting to ignore task-irrelevant semantic information. A significant increase in ERP amplitude, beginning ~ 200 ms after stimulus onset, was observed for incongruent trials when spatial navigators performed the Location task. However, a similar increase was not observed for verbal navigators. This suggests that conflict produced by task-irrelevant semantic information is rapidly processed, but only in spatial navigators.

H18

THE ROLE OF ERROR PROCESSING AND IMPULSIVENESS IN NICOTINE DEPENDENCE. Olga Rass[1], Tara Davis[1], Amy Zhang[1], Brian O'Donnell[1,2,3]; [1]Indiana University, [2]Indiana University School of Medicine, [3]Larue D. Carter Memorial Hospital — Factors that prevent long-term non-daily smokers from transitioning to daily dependent smokers are not well established.

Increased impulsivity, decreased behavioral control, and deficient error processing are possible contributors to nicotine addiction. Non-smokers, non-daily smokers, and daily smokers completed a continuous performance task during event-related potential (ERP) recording as well as self-report questionnaires. Daily smokers scored higher on experience seeking than non-smokers and higher on motor impulsiveness than both groups. Both smoking groups showed a trend for higher scores on disinhibition compared to non-smokers. No group differences were found for response time or error commission in the behavioral control task. Groups did not differ on initial error processing, measured by the event-related negativity (ERN) ERP component, suggesting intact functioning of the cingulate cortex. However group differences on the Error Positivity (Pe) component support differences in delayed evaluation of error salience and the functioning of the posterior temporal cortex circuits involved in the ventral attentional network (Helenius et al, 2010). Non-daily smokers had a stronger Pe response than smokers and non-smokers. Daily – but not non-daily – smoking was predictive of impulsive characteristics. Non-daily smoking was associated with differences in error processing, a potential neuroprotective factor in smoking dependence.

H19

ROLE OF THE ERROR-RELATED NEGATIVITY IN ERROR AWARENESS Ana Navarro Cebrian[1,2], Andrew Kayser[1,2]; [1]Ernest Gallo Clinic and Research Center, [2]University of California, San Francisco — The study of error awareness with electroencephalography has led to contradictory results. A decreased amplitude of the error-related negativity (ERN), thought to originate in medial prefrontal cortex (MPFC), has been found to be correlated with failures of error awareness in some studies, but not in others. We hypothesized that this variability could be due to differences in how experimental designs account for uncertainty. Specifically, when subjects are uncertain of a response but respond correctly, these uncertain responses might generate larger ERN amplitudes that could be misinterpreted as unaware errors. To differentiate aware errors from both unaware errors and uncertain responses, our subjects rated their responses in a flanker task as correct, incorrect, or uncertain. We found that 9.4% of their responses were aware errors, 5.3% were unaware errors and 1.6% were uncertain responses. Our preliminary results show that the ERN activates more with aware than unaware errors, indicating that MPFC activity may be related to error awareness failure. Our data also support the possibility that previous studies that found no differences between aware and unaware errors at the time of the ERN may have included uncertain responses in the unaware averages. When uncertain responses are counted as unaware errors, our data show no differences between aware and unaware errors at the time of the ERN. Finally, in agreement with some of the literature, our results demonstrate that behavioral adjustments after errors occur only when people are aware of their errors.

H20

ELECTROPHYSIOLOGICAL INDICES REFLECT TEMPORALLY-STRUCTURED EXPECTATION AND OUTCOME EVALUATION Sarah Forster[1], Joshua Brown[1]; [1]Indiana University — Current models describe the iterative shaping of expectation as the foundation for adaptive learning and decision-making. The anterior cingulate cortex (ACC) and neighboring medial prefrontal cortex (mPFC) regions are thought to be central to this process, actively representing and revising the value ascribed to action outcomes in accordance with observations. However, while outcomes have been traditionally characterized with respect to valence alone, temporal contingencies must also be represented and monitored. Recent fMRI findings are consistent with this idea, demonstrating that the mPFC responds to violations of temporal expectancy as well as violations of expected valence (Forster & Brown, 2011). The current study aims to complement and extend these findings by utilizing the enhanced temporal resolution of electrophysiological indices to delineate the temporal structure of expectation and subsequent outcome evaluation, especially within the lateral and medial prefrontal cortex. High density EEG was collected during a prediction task in which the expected latency of feedback was manipulated across blocks by presenting predominantly early (ExpectEarly), predominantly late (ExpectLate), or equal proportions early and late (ExpectEither) feedback trials. Increased anticipation of early feedback was associated with a linear increase in brain potentials over lateral prefrontal electrode sites for ExpectEarly and ExpectEither conditions but not the ExpectLate condition. In contrast, following the omission of early feedback, late feedback was 100% likely and differential anticipatory activation was not observed across expectancy conditions. During the outcome evaluation interval, manipulation of temporal expectations led to modulation of the feedback-related negativity, an event-related potential ascribed to mPFC.

LANGUAGE: Semantic

H21

WHEN CONCEPTS COMBINE: SEMANTIC PROCESSING IN THE ANGULAR GYRUS Amy Price[1], Michael Bonner[1], Jonathan Peelle[1], Murray Grossman[1]; [1]University of Pennsylvania — Thought and language rely on the brain's ability to flexibly combine concepts. For example, the word "microwave" has a semantic representation, which can be modified by adding the word "beeping" before it to make "beeping microwave". We hypothesized that such conceptual combination was supported by semantic processing in the angular gyrus. In an fMRI study, 17 participants (mean age= 25.1) read word pairs on a screen. These word pairs were divided into pairs that could plausibly combine to form a modified concept, and pairs that could not. Combinatorial word pairs contained adjectives describing features in one of four modalities: Sound ("beeping microwave"), Touch ("spongy ball "), Motion ("drifting balloon"), and Form ("plaid jacket"). A baseline condition included non-combinatorial word pairs ("galaxy tulip"). Feature associations and ability to combine were determined in norming studies. Conditions were matched for word length, frequency, orthographic neighborhood density, and concreteness. We looked for cortical regions supporting the linking of semantic concepts with a whole-brain analysis of areas that showed an increased response for combinatorial pairs compared to non-combinatorial pairs. This revealed a significant cluster centered on left angular gyrus ($p < .01$, whole-brain corrected) and no other significant clusters. We found that angular gyrus was recruited by each category of combinatorial word pairs. We demonstrate that angular gyrus is recruited as concepts are being linked to build an updated and enriched semantic representation, and that this semantic linking occurs across categories of words, suggesting that the angular gyrus functions as a heteromodal semantic integration region.

H22

FAMILIAR PERSON AND PLACE NAMES IN THE SEMANTIC SYSTEM Rutvik Desai[1], Usha Tadimeti[2], Jeffrey Binder[1]; [1]Medical College of Wisconsin, [2]Marquette University — Previous studies suggest common brain regions involved in social cognition and general semantic processing, but the reason for this overlap is not clear. We investigated BOLD responses to personally familiar (PF) and famous (F) names of people and places, to simultaneously examine effects of familiarity and category. Twenty-one subjects made a familiarity decision in the scanner for 40 names from each of the PF and F persons and places. Names with varying degrees of personal familiarity were collected in advance from each subject. We collected amount of knowledge, sensory experience, and emotional response ratings for each item after the scan. Relative to unknown names, the bilateral angular gyrus (AG), anterior/middle temporal lobe (ATL), posterior cingulate/precuneus (pCg), and hippocampus/parahippocampal gyrus were activated for all PF and F categories, with stronger activations for PF names regardless of category. Analyses using the ratings as people- and place-specific covariates revealed that the amount of knowledge and sensory experience were correlated positively with activation in the AG, ATL, and pCg for both people and places, with no significant interactions between people and place names. Nega-

tive emotional valence was correlated with higher right ATL activation. AG, ATL, and pCg are major hubs in the semantic system. AG and pCg especially respond to common nouns relative to nonwords. These results indicate automatic activation of associated knowledge and experience for both people and place names, and suggest that the overlapping activation for social and general semantic concepts is due to a common underlying knowledge retrieval process.

H23

SEMANTIC SIMILARITY BETWEEN INDIVIDUAL WORDS: AN FMRI STUDY Francesca Carota[1], Nikolaus Kriegeskorte[1], Friedemann Pulvermuller[1,2]; [1]MRC - Cognition and Brain Science Unit, [2]Freie Universität Berlin — Brain research on words and concepts has shown that semantic processing activates a range of areas, some of which reflect differences between semantic categories, for example words referring to actions and objects. However, it is unclear to which degree these areas process information about the semantic similarity between individual words and, if so, how this similarity mapping differs between brain areas and semantic types. An area responding in similar ways to semantically similar words would provide a genuine semantic processing system for these words. Representational Similarity Analysis (Kriegeskorte et al. 2008) was applied to compare semantic similarity between action- and object-related words, as measured by Latent Semantic Analysis and semantic ratings, and single-word-elicited fMRI patterns (96 words, 6 repetitions each) recorded from 23 subjects. Action-related verbs elicited similar brain activation patterns in left precentral and left supplementary motor areas. Both precentral cortex and Broca's region (BA 44 and BA 45) revealed brain activation pattern-similarity between tool nouns and verbs related to hand actions. Left inferior frontal gyrus indexed similarity between food and face words suggesting that the body part whose movement is afforded by an object or that is involved in executing an action is reflected in brain activation. In temporal pole and superior temporal cortex, semantic similarity could be mapped for sub-categories of object words, especially tool and food nouns. These results show for the first time that semantic similarity is manifest in brain activation and that semantic similarity mapping in the human cortex is sensitive to semantic categories.

H24

TRANSCRANIAL DIRECT CURRENT STIMULATION OF LEFT DORSOLATERAL PREFRONTAL CORTEX SPEEDS CONTROLLED WORD RETRIEVAL DURING VERBAL FLUENCY J. Jason van Steenburgh[1], Laura V. Bosley[1], Tracy D. Vannorsdall[1], Kara Reese[1], Megan Andrejczuk[1], David J. Schretlen[1], Barry Gordon[1]; [1]Johns Hopkins University School of Medicine — During verbal fluency productions, people appear to retrieve clusters of related words via a relatively fast automatic process and switch between clusters via a slower, more effortful controlled process. Automatic processes (i.e., clustering) likely depend on the dominant temporoparietal region, while controlled processes (i.e., switching) likely depend on the dominant dorsolateral prefrontal cortex (DLPFC). In transcranial direct current stimulation, a form of noninvasive electrical brain stimulation, anodal stimulation increases and cathodal stimulation decreases cortical excitability. We previously found that anodal stimulation over the left temporoparietal cortex speeded automatic word retrieval in healthy adults. Here we sought to test the hypothesis that anodal stimulation over the left DLPFC would enhance controlled aspects of word retrieval (i.e., switching) in terms of productivity, speed of retrieval, or both. Forty healthy right-handed adults received 30 minutes of 1 mA anodal and sham or cathodal and sham stimulation over F3, with a reference electrode placed over Cz, while they completed four 60-second letter- and category-cued fluency trials. Overall productivity, clusters and switches were tallied. Inter-word intervals were measured with the aid of a spectrograph. Anodal stimulation was associated with faster retrieval (shorter inter-word intervals) of non-clustered words (M=1.79; SD=1.87 sec) than cathodal stimulation (M=2.24; SD=2.37 sec) on semantic fluency tasks (t(397)=-2.367, p=.018). Stimulation did not affect overall productivity. These results suggest that tDCS over the left DLPFC might enhance controlled aspects of word retrieval in persons with impoverished verbal productivity due to deficient set switching for categorical information.

H25

SEMANTIC RETRIEVAL RECRUITS HETEROMODAL AND MODALITY-SPECIFIC ASSOCIATION CORTICES Michael Bonner[1], Amy Price[1], Jonathan Peelle[1], Murray Grossman[1]; [1]University of Pennsylvania, Department of Neurology — OBJECTIVE: How do we retrieve information from semantic memory? We investigate the role of executive and sensory-motor association regions in semantic retrieval in an fMRI word matching experiment, using words with strong associations in three different sensory modalities: Sight, Sound, and Manipulation. METHODS: In a BOLD fMRI study, 17 participants viewed word triads on a screen and responded by button press to indicate which of two word choices on the bottom matched the word on top. Word sets had strongly associated features (determined in a norming study) in one of three modalities: Sight (e.g., carrot: potato or lightbulb; n=22), Sound (e.g., thunder: rocket or downpour; n=22), and Manipulation (e.g., fork: chopsticks or drumstick; n=22). An Abstract word condition (e.g., saga: epic or proxy; n=22) and a pronounceable pseudoword baseline (n=22; matching task for letter similarity) were included. Conditions were matched for word length and frequency. RESULTS: Looking across all word categories, the semantic matching task recruited a region of heteromodal association cortex in superior temporal sulcus as well as an executive control region in inferior frontal cortex. Within each sensory word category, we saw activations in the corresponding modality-specific association regions: Sight words recruited visual association cortex; Sound words recruited auditory association cortex; and Manipulation words recruited motor association cortex. CONCLUSION: These results suggest that in semantic retrieval, executive control regions of inferior frontal cortex may interact with heteromodal association regions in superior temporal sulcus as well as modality-specific association regions that represent conceptual features in the semantic system.

H26

EFFECTS OF EFFICIENT FRONTO-TEMPORAL CIRCUITRY ON LEXICAL AMBIGUITY RESOLUTION: CONVERGING EVIDENCE FROM CROSS-AGE COMPARISONS IN EYE-TRACKING AND ERP DATA. Mallory Stites[1], Chia-lin Lee[1], Kara D. Federmeier[1], Elizabeth Stine-Morrow[1]; [1]University of Illinois, Urbana-Champaign — We used eye-tracking to examine how younger and older adults use syntactic and semantic information to disambiguate noun/verb (NV) homographs (e.g., park). We find that young adults exhibit inflated first fixations to NV-homographs when only syntactic cues are available for disambiguation (i.e., in syntactic prose). This effect is eliminated with the addition of disambiguating semantic information. Older adults (60+) as a group fail to show the first fixation effect in syntactic prose; they instead reread NV homographs longer. This pattern mirrors that in prior event-related potential work (Lee & Federmeier, 2009, 2011), which reported a sustained frontal negativity to NV-homographs in syntactic prose for young adults. Again, semantic constraints eliminated this effect. The frontal negativity was not observed in older adults as a group, although older adults with high verbal fluency showed the young-like pattern. Analyses of individual differences in eye-tracking patterns revealed a similar effect of verbal fluency in both young and older adults: high verbal fluency groups of both ages show only the first fixation effect, while low verbal fluency groups show only downstream costs (rereading and/or refixating NV homographs). Jointly, the eyetracking and ERP data suggest that effortful meaning selection recruits frontal brain areas important for suppressing contextually inappropriate meanings, which also slows eye movements. Efficacy of fronto-temporal circuitry, as captured by verbal fluency, predicts the success of engaging these mechanisms in both young and older adults. Failure to recruit these processes requires compensatory rereading or leads to comprehension failures (Lee & Federmeier, in press).

H27

IMPAIRED SELECTION OF THE CONTEXT-APPROPRIATE MEANING OF AMBIGUOUS WORDS IN HIGH-FUNCTIONING INDIVIDUALS WITH AUTISM: AN ERP STUDY Trevor Brothers[1], Kerry Ledoux[1], Barry Gordon[1]; [1]Johns Hopkins University — Individuals with autism are reported to have difficulty appreciating the meaning of language; the theory of weak central coherence attributes this to a deficit in using local context to constrain meaning. We examined mechanisms of contextual constraint in autism by having participants read ambiguous words in context. Event-related potentials were recorded to critical words that were semantically related to the dominant meaning of a preceding ambiguous word, and that were or were not congruent with the local sentence context. Normal controls showed an N400 congruity effect at the critical words, suggesting that they had used the local context to constrain the appropriate meaning of the ambiguous words. High-functioning individuals with autism, on the other hand, did not show this effect, suggesting a deficiency in contextual selection. Both groups showed an N400 incongruity effect to sentence-final words that were not related in meaning to any other words in the sentence, demonstrating that participants with autism are sensitive to more global aspects of meaning. Taken together, these results support the theory of weak central coherence in language comprehension in autism.

H28

ARE SEMANTIC REPRESENTATIONS OF WORDS RADICALLY DISTRIBUTED? Chris Cox[1], Mark Seidenberg[1], Jeffrey Binder[2], Rutvik Desai[2], Timothy Rogers[1]; [1]University of Wisconsin-Madison, [2]Medical College of Wisconsin — Many cognitive abilities can be localized in the brain, but other faculties may be highly distributed. Some models of semantic memory, for instance, propose that the very same neurons can encode information about distinct conceptual domains, that neighboring regions potentially encode quite different information, and that distal regions can contribute to the same representation. Neuroimaging studies of semantic memory, in contradiction to this view, often suggest that knowledge about different conceptual domains can be localized to different parts of the cortex. Such findings may partly reflect standard methods for boosting signal, such as spatial blurring, familywise correction for multiple comparisons, and averaging over subjects, all of which assume local representations that are stable across individuals. Such methods may not be well-suited to finding radically distributed neural codes, should these exist. We adopted a new approach in an analysis of event-related fMRI data collected while participants made semantic judgments for each of 900 words. Voxels carrying information about animals or artifacts were identified by training two separate classifiers (animal/nonanimal; artifact/nonartifact) with sparse logistic regression. When constrained to be very sparse, the classifiers showed above-chance generalization to novel words. The voxels selected by animal and artifact classifiers overlapped more than expected by chance, suggesting that some voxels contribute to both animal and artifact representations. Moreover, the informative voxels were widely distributed and interleaved, with their locations varying substantially across individuals—raising the possibility that representations of word meanings are radically distributed in the brain.

H29

A NOVEL LATE MEG RESPONSE REFLECTING SEMANTIC INTEGRATION Suzanne Pendl[1], Jeffrey R. Binder[1], Gwen Frishkoff, Colin J. Humphries[1], William W. Graves[1], William L. Gross[1], Sylvain Baillet[1]; [1]Medical College of Wisconsin, [2]Georgia State University — The neural events underlying semantic integration during sentence comprehension are not fully understood. This process was explored using a paradigm classically associated with the N400 component, in which constraining sentence stems were followed by completion stimuli. Completion items could be highly expected and congruous, unexpected but still congruous, unexpected and incongruous, or pseudowords. Nineteen healthy right-handed adults read these stimuli and performed meaningfulness judgments while neural responses to the completion items were measured with magnetoencephalography. Sources of the evoked magnetic field responses were estimated using distributed source modeling constrained by individual cortical anatomy. RT averaged ~1300 ms across conditions. A novel response emerged during a late time window, starting at ~825 ms and often extending beyond 1000 ms. During this time window, both congruous and incongruous words activated anterior temporal regions more than pseudowords, particularly in the right hemisphere. Among word items, incongruous words showed stronger bilateral temporal responses than expected words. We propose that this late response reflects effortful integration of the completion item with the semantic context of the sentence stem, in contrast to the earlier N400, which reflects a more automatic recognition process.

LONG-TERM MEMORY: Episodic

H30

DOES LONG-TERM MEMORY RETRIEVAL BENEFIT FROM WORKING MEMORY TRAINING? Axel Mecklinger[1,2], Anna Scheuplein[2], Emma Bridger[1,2], Julia Schneiders[1]; [1]International Research Training Group "Adaptive Minds", Saarland University, Germany, [2]Experimental Neuropsychology Unit, Saarland University, Germany — Most models of long-term memory are characterized by the view that successful memory retrieval is determined by an ensemble of cognitive control processes that are engaged during memory retrieval to meet the demands of the required memory judgments. Here we explored whether long-term memory retrieval can be improved by training a demanding working memory task. Participants performed 8 sessions of an adaptive n-back auditory working memory training with tonal sequences. There was a reliable training gain during the two week training period. Before and after training, participants performed a combined item and source recognition memory task in which spoken and written words were studied and old-new decisions together with decisions about the study format had to be given in a subsequent test phase. Relative to a passive control group with no working memory training, participants of the training group showed selectively increased memory performance in retrieval conditions in which incongruent cue-target formats (i.e. a visual target has to be retrieved upon an auditory cue and vice versa) meant memory judgments did not receive support from the perceptual similarity between (retrieval) cues and memory targets. This effect, however, was restricted to participants (n=11) with high initial n-back performance levels who also showed tentatively higher working memory gains than participants with low initial performance. These results suggest that cognitive control of memory retrieval can be improved by working memory training, but that this transfer is restricted to situations with high retrieval demands and to participants with high working memory performance.

H31

THE FN400 IS ELECTROPHYSIOLOGICALLY AND FUNCTIONALLY DISTINCT FROM THE N400 Emma Bridger[1,2], Regine Bader[1,2], Olga Kriukova[1,2], Kerstin Unger[1,3], Jérôme Rimpel[1,2], Axel Mecklinger[1,2]; [1]International Research Training Group "Adaptive Minds", Saarland University, Germany, [2]Experimental Neuropsychology Unit, Saarland University, Germany, [3]Unit for Development of Language, Learning and Action, Saarland University, Germany — The FN400 or midfrontal ERP old/new effect has been repeatedly shown to operate as a neural marker of familiarity-based recognition. It has recently been claimed, however, that there is no evidence that this effect is functionally distinct from the N400 index of semantic priming (Voss, J., & Federmeier, K., FN400 potentials are functionally identical to N400 potentials and reflect semantic processing during recognition testing, Psychophysiology, 48, 532-546, 2011). The inclusion of a semantic priming manipulation within a continuous recognition test, however, means that the specific processing demands in that study differ considerably from those traditionally assumed to underlie familiarity-based recognition. Here, we present a stronger test of the claim that the FN400 is distinct from the N400 by recording ERPs during a semantic priming

paradigm which also served as the encoding phase for a surprise subsequent recognition test phase. An N400 effect elicited in the semantic priming task demonstrated the established centro-parietal maximum, whereas the difference between correctly responded to old and new ERPs in the recognition test was maximal over frontal sites in the same time window. This pattern demonstrates qualitatively distinct electrophysiological markers associated with semantic priming and familiarity-based recognition processes and comprises direct evidence that the FN400 is electrophysiologically and functionally distinct from the N400.

H32

PHARMACOLOGICAL DISSOCIATION OF NOVELTY RESPONSES IN THE HUMAN BRAIN Nico Bunzeck[1], Marc Guitart-Masip[2,3], Ray Dolan[3], Emrah Duzel[2,4]; [1]Department of Systems Neuroscience, University Medical Center Hamburg-Eppendorf, Martinistrasse 52, 20246 Hamburg, Germany, [2]Institute of Cognitive Neuroscience, University College London, 17 Queen Square, London, WC1N 3AR, UK, [3]Wellcome Trust Centre for Neuroimaging at UCL, 12 Queen Square, London WC1N 3BG, UK, [4]Institute of Cognitive Neurology and Dementia Research, Otto von Guericke University, Leipziger Strasse 44, 39120 Magdeburg, Germany — We used functional magnetic resonance imaging (fMRI) in combination with dopaminergic or cholinergic neuropharmacology to investigate the roles of both neurotransmitters in novelty processing. In a double blind procedure, subjects were administered either 150 mg levodopa (dopamine precursor), 8 mg galantamine (acetylcholinesterase inhibitor), or placebo. During fMRI scanning, participants were presented with novel and repeated (i.e., familiar) pictures of scenes and indicated their indoor/outdoor status using button presses. As expected, within the mesolimbic system (including substantia nigra / ventral tegmental area [SN/VTA] and medial temporal lobe regions) hemodynamic responses decreased as a function of stimulus repetition (i.e., novelty or repetition suppression effects). Importantly, this effect was differentially modulated by levodopa and galantamine. While levodopa abolished mesolimbic repetition suppression effects, galantamine reversed them (i.e., it led to repetition enhancement). These results indicate that whether mesolimbic brain regions show repetition suppression, repetition enhancement, or are neutral depends on the balance of dopaminergic and cholinergic neurotransmission.

H33

DIFFERENTIAL FMRI SUBSEQUENT MEMORY FOR CONTEXT UNATTENDED TO AT BOTH STUDY AND TEST VS. ATTENDED ITEMS Yaakov Hoffman[1,2], Oded Bein[1], Niv Reggev[1], Anat Maril[1]; [1]The Hebrew University of Jerusalem, [2]Bar ilan University — Subsequent memory refers to assessment of differential neural encoding-related activation (DM) for subsequently remembered versus forgotten material. In the present study we assessed DM for context which was unattended-to at both study and test, and for its attended target. At study, composite stimuli containing (attended) black words superimposed on grey (unattended) words were presented. Participants performed an incidental encoding task of vowel counting on the black target words. A subsequent recognition test included four types of stimuli, obtained by crossing the target-context dimension with old-new status (old targets presented on old contexts; old targets presented on new contexts, new targets presented on old contexts, and new targets presented on new contexts). Stimuli with at least one old component were relevant to the DM analysis. Interaction contrasts revealed differential DM activation profiles in prefrontal cortex, associated with attended target memory and memory for the unattended context. Successful encoding-related activation for attended targets without their contexts (compared to targets presented with their original contexts) was observed in bilateral BA 10; A distinctively different activation pattern was observed for successful encoding of unattended contextual information. Results reveal that contextual information unattended-to at both study and test is not only encoded, but its encoding also qualitatively differs from that of attended targets; i.e., it is not merely a paler version of the pattern associated with attended target encoding.

H34

AGE-DIFFERENCES IN THE RETRIEVAL OF PREVIOUSLY FORGOTTEN INFORMATION: THE NEURAL CORRELATES OF INTENTIONAL FORGETTING AND INHIBITORY CONTROL Avery Rizio[1], Nancy Dennis[1]; [1]The Pennsylvania State University — Directed forgetting studies have shown that when information undergoes inhibitory-related forgetting, it is less likely to be remembered than if it had undergone encoding. However, older adults exhibit deficits in their ability to engage inhibitory processes associated with forgetting. Evidence for both the recruitment of inhibition, and age deficits therein, have only been studied during encoding. The current study aimed to investigate age-related differences in inhibition as evidenced by the neural processes that mediate retrieval. Results indicate largely overlapping neural networks in younger adults between recollection of information that was intentionally encoded, and recollection of information that was intentionally inhibited. However, recollection of that which was previously inhibited was found to engage additional activity in the right prefrontal cortex (RPFC), suggesting that this retrieval required greater effort. Older adults, however, did not exhibit an increase in RPFC activity, indicating that retrieval of inhibited items did not require more effort than retrieval of encoded items. These results suggest that older, as compared to younger adults, engage in less inhibitory-related processing during directed forgetting. Older adults did, however, exhibit greater engagement of the dorsal anterior cingulate and retrosplenial cortex for items that were intentionally remembered as compared to those that underwent intentional forgetting. Taken together, these results demonstrate that while older adults experience a reduction in selectively inhibiting irrelevant information, they still maintain the ability to selectively encode relevant information. This research contributes to the growing body of literature indicating that the dissociation between intentional and incidental forgetting is reduced with age.

H35

ASSOCIATIVE RECOGNITION WITHOUT HIPPOCAMPUS: FAST MAPPING CAN CREATE NOVEL, INFLEXIBLE MNEMONIC REPRESENTATIONS David Warren[1], Melissa Duff[1]; [1]University of Iowa — Relational memory theory (Cohen & Eichenbaum, 1993) predicts that hippocampus is necessary to bind arbitrarily co-occurring information (e.g., item-name) into relational mnemonic representations, and that these representations are flexible in retrieval and expression. In contrast, a recent report suggests that using fast mapping, hippocampal amnesic patients can learn and recognize new, arbitrary associations between novel visual stimuli and their names (Sharon et al., 2011). As yet the durability and flexibility of these associations remains unknown. We investigated these associations in bilateral hippocampal amnesic patients (n=3) and healthy comparison participants (n=2). Participants studied new associations in two conditions: explicit encoding, in which a novel item was directly associated with its name; and fast mapping, in which a pre-experimentally familiar item was presented simultaneously with a novel item and its name (nb. in this condition the novel item-name association required recognition of the familiar foil item). Healthy comparison participants showed good subsequent recognition of novel associations irrespective of study condition. No amnesic patient performed better than chance in the explicit encoding condition, but one amnesic patient performed similarly to healthy comparison participants in the fast-mapping condition. However, all three amnesic patients performed poorly in other memory tests of the same material, including recall, cued generalization, and familiarity rating. Our results suggest that hippocampal damage may not prevent the formation of very specific associative memories derived from a partly familiar context, but that those memories lack the distinctive flexibility of the hippocampus-dependent relational memories that play a crucial role in normal word learning.

H36

THE EFFECTS OF ITEM RELATEDNESS ON THE NEURAL CORRELATES OF NOVELTY DETECTION Caitlin Bowman[1], Kristina Peterson[1], Nancy Dennis[1]; [1]The Pennsylvania State University — Successful memory in recognition tests requires individuals to distinguish items encountered during study (i.e., targets) from those not presented during study (i.e., lures). Correctly identifying a lure as 'new' (i.e., correct rejection) becomes increasingly difficult the more closely lures resemble targets, leading to a greater number of lures incorrectly identified as 'old' (i.e., false alarms). The current study uses fMRI to elucidate the cognitive and neural mechanisms involved in the correct rejection of lures as a function of the relatedness between lures and targets. Overall, correctly identified new items exhibited greater activity in bilateral medial temporal lobes (MTL), early and late visual cortex, and prefrontal cortex. When compared directly, correct rejections of items unrelated to targets showed greater activity in superior temporal gyrus and inferior parietal cortex, whereas correct rejections of items closely related to targets showed greater activity in prefrontal cortex, superior parietal cortex, and visual cortex. Differences in neural networks for related and unrelated correct rejections was also examined using functional connectivity, with results showing a largely similar neural pattern. Taken together, results indicate that correct identification of unrelated lures involves bottom-up attention and utilization of categorical information and correct identification of related lures requires greater top-down attention and monitoring of perceptual details.

H37

NEGATIVE SUBSEQUENT MEMORY EFFECTS ARE ACCOMPANIED BY INCREASED FUNCTIONAL CONNECTIVITY WITHIN THE DEFAULT-MODE NETWORK Unal Sakoglu[1], Marianne de Chastelaine[1], Michael D. Rugg[1]; [1]Center for Vital Longevity and School of Behavioral and Brain Sciences, University of Texas at Dallas — Negative subsequent memory effects are identified as enhanced activity for study items that are subsequently forgotten relative to those that are subsequently remembered. Several of the regions demonstrating these effects belong to the 'default-mode network'. Thus, the effects have been interpreted as reflecting the benefit to encoding that ensues when 'default processes' are fully disengaged. Here, we investigated whether negative subsequent memory effects are accompanied by changes in functional connectivity between regions demonstrating the effects and other cortical areas. Subjects (n=18) studied a series of word pairs in a relational encoding task. Later, they discriminated between intact pairs (pairs repeated from the study phase), rearranged pairs (pairs formed from words presented on different study trials) and new pairs. Negative subsequent memory effects were identified by contrasting the activity elicited by studied pairs incorrectly judged rearranged with the activity elicited by pairs correctly judged intact. The contrast identified negative effects in several regions, most notably the posterior midline, medial prefrontal cortex, and right lateral parietal cortex. These three regions were used as seeds in separate psychophysiological interaction (PPI) analyses that identified voxels where connectivity varied according to the accuracy of the later memory judgment (intact vs. rearranged). Connectivity between each seed region and a subset of default mode regions was higher for items later judged intact than it was for items incorrectly endorsed as rearranged. Thus, negative subsequent memory effects reflect a combination of attenuated activity and increased connectivity within the default mode network.

H38

REPRESENTATIONAL SIMILARITY AND RECOGNITION MEMORY: HIGH-RESOLUTION FMRI SUPPORT FOR SUM SIMILARITY IN MTL CORTEX Karen F. LaRocque[1], Mary E. Smith[1], Nathan Witthoft[1], Valerie A. Carr[1], Kalanit Grill-Spector[1], Anthony D. Wagner[1]; [1]Stanford University — While the hippocampus and surrounding medial temporal lobe cortex (MTLc) are known to be critical for declarative memory, the nature of hippocampal and MTLc mnemonic computations remains a topic of debate. One proposed distinction is that MTLc, but not the hippocampus, is sensitive to the degree of global match (sum similarity) between a test probe and previously studied items (Norman et al., 2010). Here, we examined multi-voxel patterns of blood oxygen level-dependent (BOLD) activity in MTLc and hippocampus to assess the relationships between across-item pattern similarity and subsequent item recognition. Seventeen participants underwent high-resolution fMRI while viewing images, and then performed a post-scan item recognition memory test. For each participant, we computed correlations between the multi-voxel patterns of BOLD activity to pairs of stimuli in anatomically defined MTLc subregions and in the hippocampus. Within MTLc subregions, the magnitude of the difference between identity (item to same-item) and non-identity (item to other-item) correlations was significantly greater for subsequently forgotten items relative to subsequently remembered items. This relationship was due to higher identity correlations being predictive of subsequent forgetting, and higher non-identity correlations being predictive of subsequent remembering. By contrast, representational similarity in the hippocampus did not relate to subsequent memory. These results suggest that global match computations in the MTLc subserve item recognition memory. Support: NIMH (5R01–MH076932), NSF (IGERT-0801700), NSF (GRFP)

H39

INVESTIGATING THE RELATIONSHIP BETWEEN PRIMING AND FAMILIARITY USING EVENT-RELATED POTENTIALS Joanne Park[1], Kevin Allan[2], David Donaldson[1]; [1]University of Stirling, [2]University of Aberdeen — Does unconscious repetition priming influence conscious episodic familiarity? To address this question we measured conscious and unconscious forms of memory concurrently - but ensured that participants were unaware of the priming manipulation. We employed ERPs to investigate the timecourse and distribution of neural activity evoked during a recognition test, involving a shallow encoding task designed to encourage familiarity based retrieval. Half of the recognition trials began with a brief (48ms) masked repetition of the to-be-recognized word prior to the onset of test items (shown for 300ms). On the remaining unprimed trials onset of the to-be-recognized word was preceded by the word 'blank'. The behavioural data demonstrated (~70ms) facilitation of response times for all primed words - irrespective of study status or recognition response – but no measure of recognition performance was affected by priming. The ERP data revealed two priming-related modulations, an early (0-150ms) frontal negativity and a later (250-500ms) posterior positivity for primed vs. unprimed words. The posterior effect overlapped temporally with the bilateral frontal old/new effect (FN400, circa 300-500ms), a putative ERP correlate of familiarity. This bilateral frontal old/new effect was evident only when contrasting unprimed HIT vs. unprimed CR ERPs, and not when contrasting primed HIT vs. primed CR ERPs. We argue that these data are consistent with the existence of neural circuits supporting priming that are independent of familiarity, but that the ability of ERPs to disentangle priming from familiarity may be reduced because of component overlap in distinct effects that are concurrently activated.

LONG-TERM MEMORY: Other

H40

THE MODULATION OF ANXIETY-LIKE RESPONSES BY HUMAN BDNF POLYMORPHISM IN COMBINED CUE-CONTEXT CONDITIONING Andreatta Marta[1], Ewald Heike[1], Glotzbach Evelyn[1], Tröger Christian[1], Baumann Christian[1,2], Reif Andreas[2], Deckert Jürgen[2], Pauli Paul[1], Mühlberger Andreas[1]; [1]Department of Psychology, University of Würzburg, [2]Department of Psychiatry and Psychotheraphy, University of Würzburg — The protein Brain Derived Neurotrophic Factor (BDNF) mediates synaptic plasticity associated with memory and learning. Importantly, the 66Met variant has been associated with anxiety-related behaviors. Classical conditioning is a simple form of learning that has been implicated in the development of anxiety disorders. Here, we investigated in humans the modulation of BDNF polymorphism in context dependency of fear responses to a cue

(conditioned stimulus, CS) signaling a painful event (unconditioned stimulus, US). Thirty-five participants carrying the Met allele and thirty-five homozygous for the Val allele were guided through two virtual rooms. In one room (fear context), a colored light (CS+) was associated with a painful electric shock (US), while another light (CS-) was never associated with US. In the other room (safety context), the two lights were also presented, but no US was delivered. Fear learning was quantified by fear potentiated startle (FPS) and verbal reports for valence, arousal and anxiety. Participants carrying the BDNF Met allele showed generalized fear conditioned responses (i.e., increased FPS) to the safety context as well as slower discriminative learning between fear and safety context compared to the Met group. We did not find modulation of BDNF polymorphisms on cue conditioning as well as on verbal reports. In summary, our results support previous animal studies and extend their findings to humans. Thus, context, but not cue, fear learning was impaired in participants carrying the BDNF 66Met allele. This may be further support for the role of the Met variant as genetic predisposition to anxiety disorders.

H41

REWARD MODULATES EARLY NEURAL CATEGORY PROCESSING Thore Apitz[1], Nico Bunzeck[1]; [1]Department of Systems Neuroscience, University Medical Center Hamburg-Eppendorf — Converging evidence suggests that visual brain regions are part of a widespread network that signals forthcoming reward. However, the precise temporal dynamics underlying the interaction between visual representations of object categories and reward processing remain unclear. Here, we used magnetoencephalography (MEG) in combination with two versions of a face/scene discrimination task followed by a recognition memory test. In experiment 1, the distinction between faces and scenes was linked with monetary reward, whereas in experiment 2 subjects distinguished between both categories in the absence of reward. In both experiments characteristic neural category effects (i.e., differences between faces and scenes) were observed in the event-related magnetic field (ERF) at ~100 ms and ~170 ms after stimulus onset. Importantly, both components were amplified in the context of reward motivation (i.e. more pronounced in experiment 1) and this interaction could be source localized to the lateral occipital cortex (~100 ms) and fusiform gyrus (~ 170 ms). Furthermore, a main effect of reward emerged over frontal sensors at ~300 ms after stimulus onset which could be identified as a reliable predictor of recognition memory performance. These results suggest that reward can act as a top-down signal that directly modulates early neural computations of faces and scenes possibly by tuning of sensory neurons within the visual cortex.

H42

HIGHLIGHTING IS AMPLIFIED BY TWO FORMS OF PREFRONTAL SUPPRESSION Matthew J. Weber[1], Samuel B. Messing[2], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania, [2]Columbia University — Highlighting is a learning phenomenon in which preconditioning with one association strengthens a later-learned association. Subjects first learn that cues AB invite response X, and later, but with equal frequency, that cues AC invite response Y. After training, subjects are confronted with novel cues A and BC. Although A is associated equally strongly with responses X and Y, and B is as strongly associated with X as C is with Y, subjects do not respond equivocally to these novel cues, instead preferring response X for A and response Y for BC. Several studies suggest that highlighting is an attentional phenomenon motivated by error reduction: When subjects are confronted with cues AC, they attend away from A to dampen its learned evocation of X, thus loading the balance of Y's associability on C. Accordingly, we expected that occupying cognitive control resources with a secondary task would attenuate this attentional dynamic, reducing highlighting. Instead, the secondary task increased highlighting by about 20%. To support our assumption that the effect of the secondary task was mediated by prefrontal cortex, we suppressed left ventrolateral prefrontal cortex activity of new subjects in the same paradigm using cathodal transcranial direct current stimulation. This elicited elevated highlighting of a similar magnitude (18%), although the difference was marginally significant. We surmise that occupying or reducing cognitive control resources makes cue A more salient, forcing subjects to exert greater attentional control to avoid errors; indeed, making A more salient also increased highlighting by about 20%.

H43

RECOGNITION MEMORY IMPAIRMENTS CAUSED BY NOVEL OBJECTS FALSELY RECOGNIZED AS FAMILIAR Lok-Kin Yeung[1], Jennifer D. Ryan[1,2], Morgan D. Barense[1,2]; [1]University of Toronto, [2]Rotman Research Institute at Baycrest, Toronto — Recent studies in rodents have suggested that recognition memory impairments following perirhinal damage are caused by the misidentification of novel stimuli as being familiar. These impairments are observed under high-interference conditions, but not under low-interference conditions (McTighe et al, 2010; Burke et al, 2010). In the present study, we tested whether a similar pattern of recognition memory impairments was present in humans. In a continuous viewing task, individuals at risk for MCI and healthy controls viewed high- and low-interference novel stimuli (as determined by the amount of feature overlap with previously-studied images), as well as familiar stimuli. The tendency to disproportionally view novel relative to familiar stimuli was used as a measure of recognition memory (i.e. novel stimuli were correctly recognized as novel if they were viewed more than familiar stimuli). Compared to healthy controls, individuals at risk for MCI showed memory impairments under conditions of high interference, with reduced viewing of high-interference novel stimuli relative to familiar stimuli. In contrast, both individuals at risk for MCI and healthy controls showed intact memory under conditions of low interference, with increased viewing of low-interference novel stimuli relative to familiar stimuli. These findings suggest that recognition memory impairments under high-interference conditions in humans, as in rodents, are driven by the misidentification of novel stimuli as being familiar. Further, they are consistent with a recent representational-hierarchical view that the perirhinal cortex supports complex object-level representations necessary for mnemonic and perceptual functions (Saksida & Bussey, 2010).

H44

BEHAVIORAL AND NEURAL EFFECTS OF REWARD AND PUNISHMENT ON GENERALIZATION Suzanne Wood[1], Karin Foerde[1], Melanie Pincus[2], R. Alison Adcock[3], Daphna Shohamy[1]; [1]Columbia University, [2]Emory University, [3]Duke University — Multiple neural systems mediate learning and memory. Incremental learning of stimulus-response associations is thought to depend on the basal ganglia and dopamine, whereas rapidly formed flexible memories are thought to depend on the hippocampus. Recent work has also shown that the dopaminergic midbrain and hippocampus may cooperate during reward learning, however open questions remain about the role of dopamine in modulating hippocampal memories. In this study we examined how multiple brain systems support learning from reward vs. punishment. Participants underwent functional imaging (fMRI) while engaged in a two-phase learning and generalization task. In the first phase, participants engaged in feedback-based learning of associations under two conditions: some associations were learned by gaining a monetary reward for every correct response or nothing for incorrect responses (Reward condition), and other associations were learned by incurring a monetary loss for incorrect responses or nothing for correct responses (Punishment condition). After learning, participants' ability to generalize what they learned to novel stimulus combinations was assessed. We found that participants learned in both the reward and punishment conditions, with rewarded trials leading to enhanced generalization. We found distinct patterns of activation in the striatum, anterior insula, and the hippocampus for learning from rewards vs. punishments. In addition, ventromedial PFC showed more activation during learning for rewarded stimulus pairs that were successfully remembered later. The results suggest that distinct neural mechanisms are engaged during learning from rewards vs. punishments and can support later flexible generalization behavior, suggesting effects of reward on multiple brain systems for learning.

H45

EXPLICIT LEARNING CONFERS ADVANTAGES IN SKILL PERFORMANCE Priya Kalra[1]; [1]Harvard Graduate School of Education — Most studies to date have found that if there is an effect of explicit learning on skill performance, it is an interference of other detrimental effect (e.g. Galea et al., 2010, Brown & Robertson, 2007). Relatively little research in either educational psychology or basic cognitive psychology has explored whether "redundant" learning of a task through both memory systems confers any advantages (e.g. learning arithmetic both procedurally and conceptually). Such beneficial collaboration across memory systems, if found, could be of interest to both basic researchers and educators. The Serial Response Time Task (SRTT) can be learned purely implicitly, as shown in studies of SRTT learning and performance in amnesics (Nissen and Bullemer 1987). However, explicit knowledge of the presence of a pattern in the stimuli can affect its learning by non-impaired subjects. We tested 50 subjects on the SRTT in one of three conditions: implicit only (training, no instruction on sequence), explicit only (instruction on sequence only, no training), and explicit-implicit (both instruction on sequence and training). Following training, subjects performed two posttests: first, the SRTT in a dual-task condition with tone counting, and second, the SRTT with the pattern slightly modified (all subjects were informed of the modification). Explicit-implicit condition subjects demonstrated lower response times than implicit-only subjects in both posttests, suggesting an advantage provided by explicit knowledge of the pattern.

H46

THE HIPPOCAMPUS IN INFERENCE: DISTINCT HIPPOCAMPAL ACTIVATION FOR IMPLICIT VERSUS EXPLICIT PERFORMANCE. Anthony Greene[1], Lauren Hopkins[1], Peter Leo[1], Youcai Yang[1], Alexander Hinman[1], Patrick H. Heffernan[1], Sandra Figueira[1], Erin Browning[1], Kaila Balling[1], Omar Kattan[1]; [1]University of Wisconsin - Milwaukee — A growing literature of implicit hippocampus-dependent tasks has recently emerged to include context priming tasks as well as relational learning. In associative inference, overlapping context relations are learned at study and novel configurations requiring an inference are presented at test. Bunsey and Eichenbaum (1996) showed that the ability to make the inference at test is dependent upon the hippocampus in rats. Preston and colleagues (2004) found involvement in humans, but all participants were explicitly informed of the contingencies and the requirement to make an inference. Previous work in our lab has shown that it is possible to solve associative inference implicitly, without conscious awareness of the relational contingencies (Leo & Greene, 2008). The present study utilized an inference task to examine whether or not awareness is necessary for correct performance during untrained inference trials as well as the role of the hippocampus during these trials. The results of our study indicate that explicit and implicit performance on this task corresponds to distinct patterns of hippocampal activity. These findings are additional support that the hippocampus plays a role in implicit relational learning. Furthermore, distinct patterns of hippocampal activity rule out the possibility that low-levels of task awareness may be accounting for hippocampal activity during implicit performance.

H47

INTERFERENCE EFFECTS ON IMPLCIT AND EXPLICIT LEARNING OF SEQUENTIAL PATTERNS Katherine R. Gamble[1], Caterina P. Profaci[1], James H. Howard, Jr.[1,2,3], Darlene V. Howard[1]; [1]Department of Psychology, Georgetown University, [2]Department of Psychology, The Catholic University of America, [3]Department of Neurology, Georgetown University Medical Center — Once implicit sequence learning occurs it is retained long-term if not permanently. While this robust retention can be beneficial, it might also be detrimental. For example, knowing one language may make learning a second language easier, but learning the placement of an adverb in one language may impair correct sequencing of a sentence in another language. The present study investigated whether people can learn two different sequential patterns minutes apart, and whether learning the second pattern is impaired or improved by the first. We used the Alternating Serial Reaction Time task (ASRT) in which alternate events follow a pattern while the intervening events are determined randomly. The ASRT version used here assessed both implicit and explicit learning of the same pattern. Explicit blocks occurred under instruction to look for an alternating pattern, with different colored stimuli facilitating pattern detection, while on implicit blocks, stimuli were all black and participants were not told of the pattern. Participants completed two sessions of the ASRT with two different patterns, minutes apart. Everyone gained full declarative knowledge in the first explicit block for both patterns. Implicit learning, as measured via reaction time and accuracy differences in implicit blocks, also occurred for both patterns, but later in training for the second pattern than for the first. Thus, implicit learning of one pattern slows, but does not prevent, learning of a second pattern minutes later, even in the presence of declarative knowledge of both patterns, demonstrating the independence of implicit procedural learning from declarative.

H48

FAST MAPPING: AN ALTERNATIVE WAY OF LEARNING NEW ASSOCIATIONS Eve ATTALI[1,2], Asaf GILBOA[1,2]; [1]Rotman Research Institute at Baycrest Hospital, Toronto, [2]University of Toronto — Sharon et al. recently reported a phenomenon of rapid acquisition of novel arbitrary associations in amnesics suffering from MTL lesions. These data challenge the accepted view of dual declarative memory systems and brings about a radically different mechanism for directly acquiring semantics without enlisting the hippocampus: the Fast Mapping (FM). FM refers to a process that supports vocabulary acquisition among children who do not have a mature hippocampus. They actively infer the meaning of novel words by generating hypotheses based on contextual cues. Twelve patients suffering from Alzheimer's disease (AD) and 12 healthy controls (HC) participated in the study. Participants performed a FM task and a standard associative memory task using explicit encoding (EE). In the FM task, on each trial, one novel picture and one familiar picture appear, along with a simple perceptual question which contains the target's label. Responding yes or no, participants infer that the unknown label corresponds to the novel picture. A forced choice recognition task was administered 10 min and one week after both the FM and the EE tasks. Results show that: - HC better perform on the EE task than the FM task whereas AD patients show the reverse pattern. - AD patients perform as well as HC on the FM task whereas they are impaired in the EE task. - Associations learnt through FM remain after one week. FM is an alternative way of learning, independent of the episodic memory that can be used when the common pathway of memory is disturbed.

H49

STRESS AND FACE RECOGNITION MEMORY Webster Lincoln[1], Delight-Nicole Labrovich[1], Megumi Hosoda[1], Cheryl Chancellor-Freeland[1]; [1]San Jose State University — Stressful situations trigger the activation of the hypothalamic-pituitary-adrenal (HPA) axis and the subsequent secretion of stress hormones. In general, the effects of stress on cognition follow an inverted-U shape function, where there is an optimal level of stress and extremely high/low stress levels often result in cognitive impairment. While a majority of research investigating the effects of stress on memory has focused on hippocampal-based memory, few studies have examined the effects stress on face recognition memory. The role of the hippocampus and the perirhinal cortex in recognition memory has been subject to debate. The goal of this study is to investigate the effects of stress on face recognition and to evaluate the distinction between the recollection and familiarity. The Remember/Know procedure was used to investigate face recognition. Stress was manipulated by using the Trier Social Stress Test. In addition to significant impairment in overall facial recognition, results showed significant impairment in facial familiarity with stress in comparison to control. However, no significant differences were found on recollection (remember) between stress and control. Results are consistent with the implications of previous research. These findings support the evidence of a psychological distinction between rec-

ollection and familiarity and the involvement of distinct brain structures in both processes.

LONG-TERM MEMORY: Skill learning

H50

IMPAIRED MOTOR SKILL LEARNING, BUT INTACT MEMORY FOR TOOL ATTRIBUTES: INVESTIGATING ACQUISITION OF COMPLEX TOOL KNOWLEDGE IN PARKINSON'S DISEASE Shumita Roy[1], Norman W. Park[1], Eric A. Roy[2], Quincy Almeida[3]; [1]York University, [2]University of Waterloo, [3]Wilfrid Laurier University — OBJECTIVE: Previous research suggests that different aspects of tool knowledge are mediated by different memory systems. It has been proposed that tool attributes (e.g., function, color) are represented as declarative memory while motor skills are represented as procedural memory. However, these representations are not well understood. It has also been suggested that the two memory systems may interact during acquisition of some aspects of tool knowledge, but the nature of this interaction is still unclear. In Roy & Park (2010) an individual with hippocampal amnesia demonstrated intact motor skill acquisition, but impaired memory for tool attributes. These findings highlight the importance of declarative memory in acquiring various aspects of tool knowledge. However, the contribution of procedural memory is still unclear. METHOD: Eighteen patients with Parkinson's disease (PD) and 18 controls were trained and tested over 2 sessions, 3 weeks apart, to use six novel complex tools. RESULTS: PD patients showed a slower rate of motor skill acquisition compared to controls. In addition, PD patients, but not controls, showed slower completion time after the 3-week delay. Lastly, PD patients were comparable to controls in memory for tool attributes. CONCLUSION: Consistent with previous research, current results suggest that tool attributes are represented declaratively, while motor skill acquisition is procedural and likely mediated by basal ganglia and related structures. Taken together with Roy & Park (2010), these findings present a double dissociation of memory processes involved in acquiring tool knowledge. Current findings also raise the possibility of compensation between declarative and procedural systems.

H51

CHRONIC SUBCORTICAL STROKE ELIMINATES THE BENEFIT OF INTERLEAVED PRACTICE ON MOTOR LEARNING AND THE INTRACORTICAL EXCITABILITY Ming-Chang Chiang[1], Chien-Ho Janice Lin[2], Barbara J Knowlton[2], Renee E Shimizu[2], Omid Yazdanshenas[2], Parima Udompholkul[2], Allan D Wu[2]; [1]National Yang-Ming University, Taiwan, [2]University of California, Los Angeles — Practice of different tasks in an interleaved order generally induces superior retention compared to repetitive practice. We applied paired-pulse transcranial magnetic stimulation (TMS) to investigate whether the benefit of interleaved training is present in subcortical stroke patients and whether it is associated with changes in intracortical inhibition (SICI) and facilitation (ICF). 14 patients with subcortical stroke and 16 control subjects practiced motor sequences with the less-affected hand where a set of three 4-element sequences were arranged in a repetitive or an interleaved order over 2 days. Retention tests took place on Day 5. Subjects practiced sequences in both Repetitive and Interleaved conditions in separate sessions 2-4 weeks apart. TMS was applied over primary motor cortex as paired subthreshold-suprathreshold TMS pulses separated by interstimulus intervals of 2 (SICI) and 10 msec (ICF). We identified a significant Group by Condition interaction on response time (RT) during retention tests on Day 5 where Interleaved training led to faster RT in the control group but not the stroke patients ($p < .05$). In addition, control subjects showed reduced SICI on Day 5 over baseline after Interleaved training while stroke patients showed such reduction after Repetitive training, resulting in a significant Group by Condition interaction ($p < .05$). This interaction was not present for ICF. The results suggest that patients with subcortical stroke do not obtain the typical benefit from Interleaved training. The differential effect of training condition on corticomotor excitability suggests that subcortical stroke alters the pattern of neuroplasticity that supports enhanced motor learning.

H52

MUSIC-INDUCED DYNAMICS: MUSICAL TRAINING, MEG SIGNAL COMPLEXITY, AND AUDITORY PERCEPTION Sarah M. Carpentier[1,2], Takako Fujioka[1], Bernhard Ross[1,2], Anthony R. McIntosh[1,2]; [1]Rotman Research Institute, Baycrest, [2]University of Toronto — Music training has been suggested to lead to an enhancement in the neural activity associated with music processing. It has been proposed that brain signal complexity is a reflection of the functional capacity of that neural system. The present study tested the hypothesis that musicians have a larger repertoire of brain activity associated with musical perception then nonmusicians. We used multiscale entropy to capture the complexity of the MEG signal while musicians and nonmusicians listened to different melodies. A previous magnetic mismatch negativity study of the current data reported that the musicians were more sensitive to deviant tones in these repeated melodies. We observed that initial melody presentation elicited higher complexity in musicians compared to nonmusicians. Brain signal complexity decreased in both groups as a function of stimulus repetition. We propose that the neural networks that underlie auditory processing have a more diverse range of functioning in musicians, as compared to nonmusicians. Repetition reduces the amount of information processing and corresponding brain signal complexity.

H53

A NOVEL SEMG BASED BRAIN-COMPUTER-INTERFACE (BCI) ADMINISTERED ON AN ANDROID MOBILE PHONE Ida-Maria Skavhaug[1], Rebecca Bobell[1], Ben Vernon[1], Sanjay Joshi[1]; [1]University of California Davis — Previous work in our laboratory has shown that participants can learn to navigate a cursor to goal targets by controlling the surface electromyogram (sEMG) recorded from a site located directly above the Auricularis Superior muscle (Perez-Maldonado, Wexler & Joshi, 2010). Two-dimensional control of the cursor was achieved by manipulating the power in two separate frequency bands defined prior to testing. One of the main advantages of this newly developed paradigm is that multiple degrees of freedom are gained from a single recording site. The Auricularis muscles are responsible for re-orienting the ears independently of head movements, and are rarely used purposefully in humans. For this reason, and because the Auricularis muscles are usually accessible even to patients suffering severe neck-down paralysis, a BCI system based on sEMG from these muscles can enable individuals to control their environment without causing interruptions to other daily actions (e.g. speech and eye gaze). The aims of our current experiment were: i) to evaluate new software developed for use on a portable android phone and ii) to investigate if the ability to simultaneously manipulate power in separate frequency bands can be generalized to other muscles. Preliminary results show that able-bodied participants can use the android phone system to control a cursor by contracting Abductor Pollicis Brevis (a muscle of the thumb). Future experiments will recruit disabled participants, focusing on Auricularis Superior (or alternative accessible muscles), to establish the potential of the developed BCI for this user group.

H54

CROSS-MODAL TRANSFER OF ABSTRACT STATISTICAL STRUCTURE BENEFITS FROM SLEEP Penelope Lewis[1], Scott Cairney[1], Simon Durrant[2]; [1]School of Psychological Sciences, University of Manchester, [2]Psychology Departmetnt, Lincolin University — Recent studies have demonstrated that sleep is beneficial for extracting the essential structure or 'gist' from a set of stimuli. To date, this has been demonstrated only within a single modality. Here, we extend this work with overnight sleep monitoring and functional magnetic resonance imaging (fMRI) to demonstrate for the first time that sleep is directly involved in the transfer of abstract statistical structure from one modality to another. 36 Participants were exposed to a statistically structured sequence of 1818 auditory tones, then tested immediately for recognition of 18-tone auditory sequences which conformed to the learned statistical pattern. Subsequently, after

consolidation over thirty minutes or twenty-four hours, they were tested again with fMRI monitoring. The fMRI session included a set of 84 analogous visual test sequences in which the vertical position of visual stimuli corresponded to the pitch of an equivalent auditory sequence. Random auditory tones were played during the visual tests to prevent auditory imagery. Behaviourally, successful transfer of the statistical information from the auditory to the visual domains took place only after 24hrs of consolidation, and this transfer was predicted by the amount of slow wave sleep (SWS) obtained during the night. Functionally, we observed decreased hippocampal responses and increased striatal responses after sleep. Taken together, these findings suggest that cross-modal transfer of abstract statistical information is associated with a gradual shift from the hippocampal to the striatal memory system and that this may be mediated by SWS.

H55

EFFECTS OF LONG-TERM MUSICAL TRAINING ON NEURAL CORRELATES OF AUDITORY IMAGERY Emily B.J. Coffey[1,2,3], Sibylle C. Herholz[1,2,3], Robert J. Zatorre[1,2,3]; [1]Montreal Neurological Institute, McGill University, [2]International Laboratory for Brain, Music and Sound Research (BRAMS), [3]Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT) — Long-term musical training influences both auditory perception and cognition, but little is known about how it affects auditory imagery. Previous studies have shown that mental imagery of music recruits secondary auditory and premotor areas, and association areas in frontal and parietal lobes. The aim of the present study was to investigate the long-term effect of musical training on auditory imagery by comparing musicians and nonmusicians using functional magnetic resonance imaging. Participants listened to the beginning and imagined the continuation of familiar melodies in the scanner. To test accuracy of mental imagery, we asked participants to judge whether a subsequent probe tone correctly fit into the imagined melody. In the perception conditions, participants merely judged if the last tone of the presented melody was correct or not. In two control conditions, participants listened to random tone sequences or rested in silence. Functional data were acquired in a sparse sampling design that was optimized with respect to the expected imagery-related brain activity. Preliminary results show that both musicians and nonmusicians were able to correctly imagine the melodies as evident from their above-chance performance on the imagery task, but musicians showed better performance than nonmusicians. During imagery, a cortical network encompassing auditory, motor and association areas was activated in both groups. However, groups differed regarding their activation in the supplementary motor area. This indicates an effect of long-term music training on the motor preparation network, which is involved not only in motor, but also in auditory imagery.

H56

REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION TO THE DORSOLATERAL PREFRONTAL CORTEX MAY FACILITATE CONSOLIDATION OF INTERLEAVED MOTOR SEQUENCE LEARNING Renee E. Shimizu[1], Chien-Ho Janice Lin[1], Allan D. Wu[1], Barbara J. Knowlton[1]; [1]University of California, Los Angeles — Practicing different tasks in an interleaved order results in superior retention and transfer compared to practicing them in a blocked order. We hypothesized that the dorsolateral prefrontal cortex (DLPFC) is a neural substrate for the consolidation of interleaved motor sequence learning, and expected that post-training DLPFC perturbation would alter retention performance. Eight subjects practiced three 4-item motor sequences presented in an interleaved order with the non-dominant hand followed immediately by either real or sham 1-Hz repetitive transcranial magnetic stimulation (rTMS). Each subject received stimulation to the contralateral DLPFC for 20 minutes. Subjects returned for a retention test of the practiced sequences 24 hours later. We used a within-subjects design with each subject participating in the other rTMS condition (real or sham) three weeks later, using a different set of sequences. Response accuracy was better at retention after receiving real rTMS compared to sham, with this difference being most pronounced in the first third of retention ($p = .033$). Following real rTMS, there was also a trend for better retention in response time, with less slowing at the retention test compared to following sham rTMS (Cohen's $d = 0.648$; medium effect size). These results suggest that 1-Hz rTMS may facilitate consolidation of motor sequence learning, or may interfere with the consolidation of competing memory representations.

H57

COORDINATED ACTION SELECTION AND TIMING RESPONSES SEPARATED ACROSS HANDS ARE INTEGRATED IN SEQUENCE LEARNING Daniel J. Sanchez[1], Eric N. Yarnik[1], Paul J. Reber[1]; [1]Northwestern University — Previous work examining the integration of sequential response order and timing with the Serial Interception Sequence Learning (SISL) task has shown that these two sources of information are integrated during learning (Gobel, Sanchez, & Reber, 2011). This produces a surprisingly inflexible knowledge representation which resists transfer to very similar motor sequences. To test the hypothesis that this inflexibility arose from the need to combine order and timing information into a single keypress response, SISL learning was examined with a manipulandum (simulated guitar) that separated action selection and response timing across hands and required a bimanually coordinated response on each trial. Participants completed 2880 trials of training on the SISL task in which precisely-timed motor responses were made to cues moving along one of four columns that followed a covertly embedded repeating sequence of cue order and inter-cue timing. At test, the order of cue responses and inter-cue timing were separately manipulated from the trained sequence in order to assess transfer to sequences with novel timing or novel order. Participants exhibited sequence-specific performance improvements for only the trained sequence and performance was equivalent to an unpracticed sequence if either timing or order was disrupted. Separate examination of each hand individually also failed to show any evidence of partial transfer from the trained sequence. When response timing and order are both necessary for accurate coordinated sequence performance, they become integrated in the motor plan that is necessary for expression even when expressed largely through different hands.

H58

DISENGAGEMENT OF INTERACTING BRAIN SYSTEMS CAN BOOST HUMAN LEARNING Dezso Nemeth[1,2], Karolina Janacsek[1], Bertalan Polner[1], Zoltan Ambrus Kovacs[1]; [1]University of Szeged, Szeged, Hungary, [2]University of Texas, Austin — Human learning and memory depend on multiple cognitive systems related to dissociable brain structures. These systems interact not only in cooperative but sometimes competitive ways in optimizing performance. It has been previously demonstrated that functional brain connectivity is reduced in hypnosis, and this is especially typical for frontal areas. The main question of our study was how the disruption of frontal lobe functions affects performance in basal-ganglia dependent sequence learning. Fourteen highly hypnotizable, healthy adults participated in the experiment. Sequence learning was measured by the Alternating Serial Reaction Time (ASRT) task. Participants performed the ASRT task in waking alert and hypnotic state. We found improved sequence learning in the hypnosis condition compared to the alert condition. Our result provides support for the idea that learning and memory processes may not only involve the engagement of specific neuroplastic mechanisms, but may also rely upon the disengagement of interacting brain systems. The improved sequence learning in hypnosis could be attributed to the reduction of interconnectivity between brain areas, especially the connections of the frontal lobe, which results in the disruption of attentional control and executive system. This result sheds light not only on the competitive nature of brain systems in cognitive processes, but also could lead to further research on improving human skill learning.

H59

ALTERED STRIATAL ACTIVATION DURING COGNITIVE SKILL LEARNING IN NON-AFFECTED SIBLINGS OF INDIVIDUALS WITH SCHIZOPHRENIA Dana Wagshal[1], Nanthia A. Suthana[1], Barbara J. Knowlton[1], Jessica R. Cohen[2], Russell A. Poldrack[3], Susan Y. Bookheimer[4], Robert M. Bilder[4], Robert F. Asarnow[4]; [1]University of California, Los Angeles, [2]University of California, Berkeley, [3]Imaging Research Center and Departments of Psychology and Neurobiology at University of Texas at Austin, [4]David Geffen School of Medicine at University of California, Los Angeles — Patients with schizophrenia show deficits in skill learning. Recently, we have shown that adolescents, who are siblings of patients with Childhood Onset Schizophrenia (COS), exhibit deficits in a probabilistic classification task (weather prediction). Here, we used fMRI to investigate whether siblings of COS patients display different patterns of neural activation during learning in the weather prediction task. Ten adolescent siblings of COS patients and 30 matched controls learned the task over two days. Performance differences between the groups emerged within the first 50 trials of training: the controls showed significant learning while the COS siblings did not. Furthermore, after extended training of over 800 additional trials, the COS siblings reached a lower level of asymptotic performance than controls. Subjects were scanned in two runs, one at the beginning and one at the end of the two days of training. We identified ROIs using the whole brain group-level analysis (cluster-corrected thresholded at $p = 0.05$) and then defined functionally by a task-baseline contrast. ROIs in the striatum showed significant interactions between group and run for BOLD signal. In the left caudate there was a significant interaction of run x group ($p = 0.014$). Also, in the bilateral putamen, there was a significant interaction of run x group ($p = 0.018$). These regions demonstrated increased activity early in training and decreased activity after extensive training in the COS siblings, while the controls maintained or increased levels of activation across runs. These results suggest that striatal dysfunction may reflect genetic liability for schizophrenia.

H60

THE ROLE OF M1 IN IMPLICIT LEARNING AND THE PROCESSING OF REWARD. Leonora Wilkinson[1], Mooshagian Eric[1], Zimmermann Trelawny[1], Lewis Jeff[1], Wassermann Eric[1]; [1]National Institute of Neurological Disorders and Sroke — The basal ganglia and its cortical connections, including the primary motor cortex (M1) play an important role in both implicit/unconscious motor sequence learning and processing of reward. Continuous burst transcranial magnetic stimulation (cTBS) reduces motor cortex excitability. We examined the effect of cTBS over M1 on implicit sequence learning with and without reward, using a probabilistic serial reaction time paradigm. We investigated implicit sequence learning with and without reward in two healthy groups after cTBS to M1 or sham. There was no overall effect of reward on learning. However, cTBS produced more impairment of learning in the unrewarded than the rewarded condition. Reward appears to protect learning against the effect of cTBS to M1 and may be a way of overcoming learning impairments in clinical settings.

H61

DISTINCT EFFECTS OF TRIAL SPACING ON PERCEPTUAL LEARNING AND GENERALIZATION. David F. Little[1], Yu-Xuan Zhang[2], Beverly A. Wright[1]; [1]Northwestern University, [2]MRC Institute of Hearing Research, Nottingham, United Kingdom — Learning on a trained condition and generalization to untrained conditions are thought to stem from the same processes. If so, learning and generalization should be equally affected by manipulations of the training regimen. To test this idea, we asked how the spacing of training trials affected learning and generalization on an auditory frequency-discrimination task. For this task, practicing 720-900 trials/day for 6-8 days using a standard composed of two brief 1-kHz tones separated by 100 ms yields improvement on that condition and on an untrained condition (1 kHz, 50 ms). We asked how performance on those same conditions was affected by two new 7-8 day training regimens: 720 training-trials/day with either a 30-minute break after 360 trials (n=8) or 6-minute breaks after every 120 trials (n=7). For the trained condition (1 kHz, 100 ms), neither trained group improved significantly more than controls (who received no training) between pre- and post-training tests, though the 6-minute group showed a trend in that direction. In contrast, for the untrained condition (1 kHz, 50 ms), the 30-minute group showed clear improvement while the 6-minute group showed none. Thus, the 6-minute regimen yielded minimal learning and no generalization while the 30-minute regimen yielded no learning but clear generalization. These results suggest that learning and generalization come from at least partially distinct processes which are differentially sensitive to the spacing of practice trials, and that training can improve performance on untrained conditions without affecting performance on a trained one. [Supported by NIH]

H62

MULTIPLE FUNCTIONS OF DOPAMINE DURING HUMAN CATEGORY LEARNING: A GENETIC TRIPLE DISSOCIATION Benjamin O. Turner[1], Erick J. Paul[1], Sebastien Helie[1], F. Gregory Ashby[1]; [1]University of California, Santa Barbara — There is growing evidence that different brain systems mediate rule-based and procedural category learning (Ashby & Maddox, 2011). Rule-based category learning relies on a network including the prefrontal cortex, while procedural category learning relies on the striatum. The performance of both systems is affected by dopamine (DA) levels: in the prefrontal cortex, it has been suggested that DA improves working memory functions (Cools, 2006); in the striatum, DA is proposed to function as a learning signal (Schultz et al., 1997). However, prefrontal and striatal DA levels can differ across individuals as a function of genotypes for three genes: DA transporter (DAT1), DA-and-cAMP-regulated phosphoprotein (DARPP-32), and catechol-O-methyltransferase (COMT). We tested 151 participants in both rule-based and procedural category learning tasks. A genotype of the DAT1 gene—associated with faster striatal DA degradation—manifests improved performance in procedural, but not rule-based, category learning. Likewise, a genotype of the COMT gene resulting in reduced DA degradation in the prefrontal cortex was associated with better performance exclusively in the rule-based task. Finally, a genotype of the DARPP-32 gene related to reduced frontostriatal connectivity correlated with improved stimulus-response associative learning in the rule-based task, but with no other behavioral measures in either task. This triple dissociation is in line with the different roles of DA in rule-based and procedural category learning. More generally, these results are an important first step in explaining the individual differences in rule-based and procedural category learning using a methodology at the crossroad of cognitive neuroscience and genetics.

H63

THE EFFECTS OF DIVIDING ATTENTION AT ENCODING ON NOVEL NATURALISTIC ACTION PERFORMANCE IN STROKE PATIENTS Sabrina Lombardi[1], Norman W. Park[1]; [1]York University — OBJECTIVE: Several studies have proposed that performing a secondary task during presentation of studied material into memory, disrupts efficient encoding of new information. Previous research has shown that dividing attention during encoding created a decline in performance of novel naturalistic actions (NNAs; e.g., building a mock volcano). In the current study, we examined the effects of dividing attention at encoding on memory for NNAs in stroke patients and controls. We anticipated that dividing attention would result in a greater number of omission (omitting an action) and commission (committing an action in error) errors, but that memory for NNAs would be disrupted to a greater extent in stroke patients than controls. METHOD: Eighteen stroke patients and 18 controls viewed a video depicting enactment of a NNA, after which they were required to reproduce what they saw. A secondary tone counting task was performed during the divided attention condition. RESULTS: Dividing attention at encoding resulted in an increase in omission errors for both stroke patients and controls. In addition, stroke patients omitted more actions at full and divided attention than controls. Interestingly, controls, but not stroke patients, showed an increase in commission errors when

attention was divided. CONCLUSION: Dividing attention at encoding resulted in higher omission errors for both groups. Increased commission errors for controls, but not stroke, may suggest that controls are more likely to form a partial memory trace of the NNA, whereas stroke patients may have a more impoverished memory for NNAs, resulting in greater omission than commission errors.

PERCEPTION & ACTION: Multisensory

H64

FUNCTIONAL NEUROANATOMICAL CHANGES INDUCED BY MU-BASED NEUROFEEDBACK TRAINING IN CHILDREN ON THE AUTISM SPECTRUM Jaime A. Pineda[1,2], Mike Datko[1], Ralph-Axel Mueller[3]; [1]Cognitive Science Department, UCSD, [2]Group in Neurosciences, UCSD, [3]Psychology Department, SDSU — Autism Spectrum Disorders (ASD) may arise from atypical anatomical and functional connections and therefore produce abnormal activity among different regions of the brain. This type of 'disconnection syndrome' could lead to desynchronization and ineffective intra- and interhemispheric communication in neural circuits affecting higher order cognitive processes. While no single explanation can account for the ASD profile, converging evidence implicates the human mirror neuron system (MNS). Studies from our laboratory have shown that ASD individuals exhibit normal EEG mu rhythm suppression for self-generated movement but fail to suppress during observation of movement compared to typically developing (TD) controls. On the other hand, suppression is normal if the actors being observed are familiar, suggesting that the MNS is not entirely broken. We have shown that significant improvement occurs in social engagement and related behaviors, as well as in the electrophysiology of ASD children following neurofeedback training focused on the mu-rhythm. The present study tested whether functional neuroanatomical changes occur after mu-based neurofeedback training (45 min x 2 week x 20 weeks). Before training, greater activation occurred in regions of interest related to MNS in TD compared to ASD during object-oriented imitation and observation. Abnormal functional connectivity, under- and over-connectivity, were also present in ASD compared to TD groups among MNS areas. Altering mu rhythm dynamics with training was found to result in increased activity in the inferior frontal gyrus (IFG) and other relevant MNS areas, as well as normalization of functional connectivity in the MNS circuits in ASD children.

H65

AUDIOVISUAL TEMPORAL FUSION IN 6-MONTH-OLD INFANTS Franziska Kopp[1], Ulman Lindenberger[1]; [1]Max Planck Institute for Human Development Berlin — Research in adults indicates that perceptual fusion of temporally disparate audiovisual events recruits neural networks that differ from those related to the evaluation of audiovisual temporal coincidence. However, it is largely unknown how these processes work early in ontogeny. In infants, audiovisual temporal disparities below 300-350 ms are correlated to simultaneity perception. 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. In synchronous trials the visual and the auditory stream were in synchrony, whereas in asynchronous trials the visual stream was delayed to the auditory stream by 200 ms. In contrast to the behavioral data, ERP data revealed that brain activity differed between the two conditions. In particular, differences due to audiovisual temporal correspondence were observed in auditory P2 peak amplitudes. Moreover, significant Pb and Nc amplitude differences between synchronous and asynchronous presentations before sound onset suggest anticipatory mechanisms in the infant brain. Results suggest contributions of different brain networks to the perception of temporally synchronous versus perceptually fused audiovisual events.

H66

EXAMINING THE EFFECT OF SOUND ON THE SENSITIVITY OF VISUAL TIME PERCEPTION IN VOLLEYBALL ATHLETES Chiu-Chan Chou[1], Yu-Ling Shih[1]; [1]Institute of Athletics, National Taiwan Sport University, Taichung, Taiwan — Coordinated movement depends on efficient multisensory integration and accurate time perception. Auditory dominance of audiovisual time perception may be modulated by long-term training of sport highly emphasizing accurate time perception. Nevertheless, the experience of sports training would cast a differential effect on visual time perception. Although sports like volleyball and dancing both stress accurate time perception for successful performance, the strategies used may differ. Therefore, the purpose of the study was to investigate the effect of sound on the sensitivity of visual time perception. Three groups of participants, namely volleyball, dancing and novice, were recruited in the present study. There were 20 participants in each group and they were instructed to compare the duration of two visual circles in either no tone or tone condition. The reaction time (RT) of volleyball athletes was significantly shorter than that of novices whereas no significant differences of RT were found between novices and dancing athletes nor between volleyball and dancing athletes in no tone condition. The error rate of volleyball athletes was significantly lower than both novices and dancing athletes in tone condition. In addition, there were no significant differences of error rate between dancing athletes and novices. Faster response for visual time perception observed only in volleyball athletes suggests that they benefit more by sport-specific training in perceptual stage of visual information processing. The sound facilitation effect, i.e. volleyball athletes perceive visual time more accurately by the presence of a tone, may result from the perceptual strategies developed from volleyball skill training.

H67

ENHANCED CORTICAL EXCITABILITY IN GRAPHEME-COLOUR SYNAESTHESIA AND ITS MODULATION Devin Terhune[1], Sarah Tai[1], Alan Cowey[1], Tudor Popescu[1], Roi Cohen Kadosh[1]; [1]University of Oxford — Synaesthesia is an unusual condition characterized by the over-binding of two or more features and the concomitant automatic and conscious experience of atypical, ancillary images or perceptions. Previous research suggests that synaesthetes display enhanced modality-specific perceptual processing but it remains unclear whether enhanced processing contributes to conscious awareness of colour photisms. In three experiments, we investigated whether grapheme-colour synaesthesia is characterized by enhanced cortical excitability in primary visual cortex and the role played by this hyperexcitability in the expression of synaesthesia. Using transcranial magnetic stimulation, we show that synaesthetes display three-fold lower phosphene thresholds than controls during stimulation of the primary visual cortex. We next used transcranial direct current stimulation to discriminate between two competing hypotheses of the role of hyperexcitability in the expression of synaesthesia. We demonstrate that synaesthesia can be selectively augmented with cathodal stimulation and attenuated with anodal stimulation of primary visual cortex. A control task revealed that the effect of the brain stimulation was specific to the experience of synaesthesia. These results indicate that hyperexcitability acts as a source of noise in visual cortex that influences the availability of the neuronal signals underlying conscious awareness of synaesthetic photisms.

H68

YOU CAN'T ESCAPE THE PAST: CROSS-MODAL BIAS CONTINGENT UPON THE PREVIOUS TRIAL Alfred Yu[1,2], W. David Hairston[1,3]; [1]US Army Research Laboratory, Human Research and Engineering Directorate, Aberdeen Proving Ground, MD, [2]Washington University in St. Louis, [3]Wake Forest University — Previous work has shown tremendous localization biases that can occur when there is a conflict between senses. Recent evidence

suggests that these effects are not necessarily transient, but in fact carry over to affect the perception of following events. For example, in the ventriloquism aftereffect, cross-modal adaptation leads an individual's auditory map to be biased by the presence of a consistent spatial disparity between co-occuring auditory and visual stimuli after only a few seconds of exposure (Wozny & Shams, 2011), suggesting a sensitivity to the sequence of spatial disparity experienced on preceding trials. We investigated the relationship between previous exposure to cross-modal discrepancy and the extent of bias observed at the present moment, and how this relationship is dependent on awareness of the discrepancy. Subjects performed an auditory localization judgment in the presence of a spatially discrepant visual stimulus followed by a subjective judgment of unity in a continuous stream. We found that the degree of bias shown on the current trial was dependent on the previous perception of unity, the extent of bias observed on the previous trial, and the consistency in the discrepancy over past trials. These findings suggest that remapping of auditory space can occur on a trial-by-trial basis, and that this sensory recalibration is dependent on not only the history of exposure to cross-modal discrepancy, but also on the subjective experience of perceptual unity. This approach lends itself to continuous measures of sensory recalibration, and can thus be used to monitor performance in real-world settings.

H69

INCIDENTAL AND CONTEXT-RESPONSIVE ACTIVATION OF FUNCTION-BASED ACTION FEATURES DURING OBJECT IDENTIFICATION: EVIDENCE FROM LEFT-HEMISPHERE STROKE Chia-lin Lee[1], Daniel Mirman[1], Laurel Buxbaum[1]; [1]Moss Rehabilitation Research Institute, Philadelphia, PA — Both structure-based (grasp-to-move) and function-based (skilled use) actions are activated incidentally during object identification, with different temporal dynamics, indicating that these representations are separable (Lee et al, submitted). Using eyetracking, we assessed the hypothesis that deficits in skilled object use should be associated with deficient implicit activation of skilled use action information. Participants were 19 left hemisphere stroke patients, 8 with apraxia, a disorder of object use. Similar prior investigations (Myung et al. 2010) have shown that apraxics are sensitive to action similarity among objects, but have not dissociated structure-based and function-based actions. We assessed the temporal dynamics of participants' eye gaze to target objects as well as distractor objects sharing function-based, but not structure-based, action features with targets (e.g., remote-control/keyfob). Targets were auditorily presented in neutral contexts ('He saw the…') or contexts containing an action verb ('He used the…'). As previously shown with healthy participants, non-apraxics fixated action-related distractors more than unrelated distractors in both contexts (p ? .001), indicating intact incidental activation of skilled use action representations. In contrast, apraxics showed significant competition effects in the action verb context (p = .005) but not in the neutral context (p = 0.5). These data suggest, contrary to the findings of Myung et al (2010), that object-use impairments are associated with an absence of incidental activation of skilled use action features during object processing unless additional contextual information is provided.

H70

MULTISENSORY CONVERGENCE OF VISION AND HAPTICS ACROSS DEVELOPMENT R. Joanne Jao[1], Thomas W. James[1], Karin H. James[1]; [1]Indiana University — As perceptual agents situated within an environment, learning relies directly on multisensory experience that is gained through sensorimotor interactions with objects in the environment. This in turn drives perception. Thus, the study of active perception (e.g., haptic or visuohaptic manipulation) provides an ideal platform for studying the development of the neural mechanisms of sensorimotor abilities, object recognition, and cognition. Three groups of participants, 4- to 5.5-year-olds (N = 15), 7- to 8.5-year-olds (N = 13), and adults (N = 8), were included in an fMRI study investigating the neural development of multisensory systems at two sites of visuohaptic convergence: the lateral occipital tactile-visual region (LOtv) for object recognition, and the intraparietal sulcus (IPS) for object-directed motor actions. Participants were tested in a block design involving visual exploration of two-dimensional images of objects and textures, and haptic exploration of their three-dimensional counterparts. By contrasting objects and textures in both sensory modalities, multisensory shape-selective BOLD responses were assessed across the younger age groups and compared to adults. Results indicated that similar neural systems were recruited for shape-selectivity in children as in adults, but to a much lesser degree (as measured by peak BOLD activation and extent). Furthermore, as compared with adults, the youngest cohort exhibited a weak overlap between haptic and visual shape-selective processes in LOtv, while the older children exhibited little overlap between conditions in IPS. These results suggest that the development of multisensory systems for object recognition is nonlinearly modulated by increased experience through active perception and exploration.

H71

SIGHT AND SOUND CONVERGE TO FORM SUPRAMODAL REPRESENTATIONS IN THE POSTERIOR SUPERIOR TEMPORAL SULCUS Kingson Man[1], Jonas Kaplan[1], Antonio Damasio[1], Kaspar Meyer[1]; [1]University of Southern California — How do streams of information from different sensory modalities converge to form higher-order supramodal representations? Would the experience of hearing the ding-dong of a bell, on the one hand, and watching a bell swing back and forth, on the other, activate a common representation for a "bell" concept? We performed crossmodal multivariate pattern analysis (MVPA) of fMRI data to probe for supramodal representations, or patterns of brain activity that met the following two conditions: (1) modality-independence, in which an object presented in different sensory modalities nevertheless evokes similar patterns of neural activity, and (2) content-specificity, in which the pattern of neural activity evoked by one object is distinguishable from the patterns evoked by other objects. We acquired fMRI data from eight subjects while they were shown audio clips and video clips corresponding to six concrete objects. A GLM analysis identified four multisensory regions co-activating to auditory and visual stimuli. Cross-modal MVPA was then performed on a separate set of data, using these regions. A machine-learning classifier was trained on activity patterns evoked by video clips and then tested on patterns from the corresponding audio clips. Of the four multisensory regions of interest, only the posterior superior temporal sulcus (pSTS) was found to contain supramodal representations. An additional crossmodal searchlight analysis also revealed a focal region within pSTS. We interpret these results within a theoretical framework in which sensory information is integrated and rebroadcast by convergence-divergence zones. Finally, we discuss the relevance of these results to concept empiricism in philosophy.

H72

AUTISTIC TRAITS ARE ASSOCIATED WITH DIMINISHED NEURAL RESPONSE TO AFFECTIVE TOUCH Avery Voos[1], Kevin Pelphrey[1], Martha Kaiser[1]; [1]Yale University — Pleasant, gentle touch has been linked to a class of slow-conducting, unmyelinated nerves, CT afferents, present only in the hairy skin of mammals. Microneurography studies have shown that CT-optimal stroking speeds range from 1-10 cm/s (Loken et al., 2009), and are rated as more pleasant than both faster and slower speeds. Such slow, gentle touch is reminiscent of that seen in social interactions, and several key nodes of the 'social brain' were recently identified in processing such touch (Gordon et al, 2011). Given the importance of such 'affective touch' in social relationships, the current functional magnetic resonance imaging (fMRI) study aimed to replicate the finding of 'social brain' involvement in processing CT-targeted touch and to examine the relationship between the neural response and individuals' autistic traits. Nineteen healthy adults received alternating blocks of slow (CT-optimal) and fast (non-optimal) brushing to the forearm followed by filling out the Autism Spectrum Quotient (AQ) . Relative to fast touch, the slow touch activated contralateral insula, superior temporal sulcus (STS), medial prefrontal cortex (mPFC), orbitofrontal cortex (OFC), and

amygdala. Connectivity analyses revealed co-activation of the mPFC, insula and amygdala during slow touch. Participants' autistic traits negatively correlated with the response to slow touch in the OFC and STS. The current study highlights the involvement of a network of 'social brain' regions in processing CT-targeted touch, while the correlation between brain response and level of autistic traits illustrates a tight coupling of social behavior and brain function in typical adults.

H73

TRAINING-RELATED CHANGES IN THE CORTICAL NETWORKS FOR MENTAL AUDITORY IMAGERY AND AUDITORY PERCEPTION Sibylle C. Herholz[1,2,3], Emily B.J. Coffey[1,2,3], Robert J. Zatorre[1,2,3]; [1]Montreal Neurological Institute, McGill University, [2]International Laboratory for Brain, Music and Sound Research (BRAMS), [3]Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT) — Short-term training has the potential to alter neuronal correlates of auditory perception, for example processing of short melodies within auditory cortex, but effects on higher-order auditory cognition such as mental imagery are still unclear. We used functional magnetic resonance imaging to investigate training-related plasticity in the cortical networks for auditory processing and mental imagery. 15 young adults with very little previous musical experience were scanned at three times, each separated by two six-week intervals: a baseline interval without training, followed by six weeks of piano training during which two subgroups were trained on different sets of melodies. Functional data were acquired in a sparse sampling design during which participants listened to familiar tunes, imagined them cued by the first tones of the song, listened to random tones as control condition, or rested in silence. Participants were able to accurately imagine the songs as evidenced by their above-chance performance in judging correct or incorrect continuations of the melodies following the imagery interval. Preliminary functional data revealed no changes during the first six weeks without training (baseline), but increased activity post-training compared to pre-training in left premotor, prefrontal and parietal cortex for both listen and auditory imagery conditions. Comparison of trained versus untrained familiar melodies revealed additional effects in parietal association areas. The results of this short-term auditor-motor training study reveal plastic changes in areas related to motor preparation and cross-modal integration. We demonstrate for the first time that similar changes occur within the cortical networks for perception and for mental imagery.

H74

'TRANSCRANIAL ELECTRICAL CURRENTS TO PROBE CROSSMODAL PHOSPHENES Silvia Convento[1], Nadia Bolognini[1,2], Chiara Galantini[1], Giuseppe Vallar[1,2]; [1]University of Milano-Bicocca, [2]IRCCS Istituto Auxologico Italiano, Milan — Crossmodal interactions occur not only within brain regions deemed heteromodal, but also in primary sensory areas, traditionally considered as modality-specific. This view is strengthened by evidence showing crossmodal enhancement of visual phosphenes induced by single pulse TMS (sTMS) over the occipital cortex. In the present study, we took advantage of the possibility to induce polarity-specific excitability changes by using the non-invasive neuromodulation technique transcranial direct current stimulation (tDCS) in order to explore whether crossmodal influences on phosphene perception are sensitive to the polarization of brain regions presumably mediating multisensory interactions in early visual areas. In a series of experiments, participants underwent a phosphene detection task in different sensory conditions: Unimodal (occipital sTMS delivered alone), Bimodal (sTMS paired with a sound or a touch), or Trimodal (sTMS paired with both sound and touch). Anodal or sham tDCS were applied to the occipital, temporal, or posterior parietal cortices, prior to task delivery. Results show that crossmodal interactions enhance cortical excitability in low-level visual areas, facilitating visual perception both in term of detection accuracy and judgement of brightness of the visual event. In particular, the more sensory information are combined, the bigger is the benefit on phosphene perception. Moreover, we demonstrate that tDCS can modulate these effects, likely influencing causal interactions between remote but interconnected heteromodal parietal regions and early visual areas. These findings shed further light on the neural mechanism subtending crossmodal influences on sensory-specific brain regions and indicate tDCS as a practical tool to manipulate cortical networks supporting multisensory interactions.

H75

ANATOMICAL CONNECTIONS BETWEEN THE COCHLEAR NUCLEUS AND PRIMARY AUDITORY CORTEX PREDICT SOUND-INDUCED FACILITATION OF VISUAL TARGET DETECTION IN HUMANS Ruud van den Brink[1], Michael Cohen[1], Erik van der Burg[2], Durk Talsma[3], Marlies Vissers[1], Heleen Slagter[1]; [1]University of Amsterdam, [2]Free University of Amsterdam, [3]Ghent University — Auditory signals can improve detection of concurrent visual targets. However, it remains debated how sounds facilitate visual target detection. Some researchers have suggested that cross-modal enhancement of target detection is mediated by connections between low-level sensory brain areas, while others have argued that top-down attention governs this effect. Here we directly tested the former hypothesis using diffusion-weighted magnetic resonance imaging. Subjects detected visual targets, and occasional auditory tones co-occurred with target stimuli. Each subject's primary auditory cortex (A1) was localized using fMRI and an auditory localizer task. Replicating previous findings, behavioral analyses showed that non-spatial sounds can facilitate spatial detection of visual targets in a distracter display. Importantly, cross-subject correlation analyses showed that the strength of connections between A1, the auditory thalamus, and the cochlear nucleus in the brainstem predicted this sound-induced visual-target detection benefit. These findings indicate that pathways between the first relay station in the auditory system and A1 determine one's ability to benefit from an auditory cue, and implicate low-level connections in cross-modal attention in humans. More generally, these findings suggest that cross-modal enhancement is governed by brain anatomy.

H76

MY TOOL HURTS! MODULATION OF PAIN ANTICIPATION IN THE PERIPERSONAL SPACE Angela Rossetti[1], Daniele Romano[1], Angelo Maravita[1], Nadia Bolognini[1,2]; [1]University of Milano-Bicocca, [2]IRCCS Istituto Auxologico Italiano — Peripersonal space is the region closely surrounding our bodies. Within its boundaries avoidance of threatening objects is crucial for surviving. Here, we explored autonomic responses to painful stimuli with respect to the dynamic properties of the peripersonal space. To this aim, we recorded in healthy subjects Skin Conductance Response (SCR) in response to an approaching painful stimulus, i.e. a needle presented at different distance from the body (far, near or on the hand). Results showed that the SCR increased as the needle approached the hand. Interestingly, this pattern of activation could be modified by active tool-use which extended reachable space. Indeed, in a second experiment we demonstrated that after training with a tool to reach distant objects, SCR increased solely to painful stimuli presented far from the body. Following control experiments showed that the increase of SCR in far space disappeared if the subject did not hold the tool, and that the modulation of SCR was absent after training in far space without using the tool. Overall, these findings demonstrated that the anticipation response of pain depends critically on the proximity of the threat to the relevant body part in external space, being more intense when the threat approaches our body. However, the spatial coding of approaching painful stimuli can be effectively influenced by acting on the far space. This evidence sheds novel light on mechanisms of pain anticipation and their relationship with the representation of peri- and extra-personal space.

H77

GENERALIZATION OF PERCEPTUAL LEARNING USING A VISUAL-TO-AUDITORY SENSORY SUBSTITUTION DEVICE. David J Brown[1]; [1]Queen Mary University of London — Sensory substitution devices (SSD) convert one type of sensory signal into another and therefore may be used to facilitate everyday functioning in individuals with some form of sensory

loss. For example, one visual-to-auditory SSD, The vOICe (Meijer, 1992) converts visual features (brightness, spatial position) into auditory features (amplitude, pitch, and time). Whilst efficacy has been demonstrated for both object recognition and localisation using SSD's the neural basis is still unclear. Adapting an established unimodal paradigm we tested sighted blindfolded participants in an interval discrimination task using a sonified visual image. Three groups, varying in number of training days, were trained on a specific monaural temporal interval (90ms, 1khz) and then tested on 3 novel alternate stimuli (interval, frequency and binaural input) to try and ascertain which features of the conversion algorithm were driving the generalization and when on the time course paradigm this learning transfer occurs. Results indicate rapid specific perceptual learning to the trained stimulus and a significant trend for generalization to both the untrained frequency (as found in the auditory paradigm) and untrained temporal interval (novel) for the longest 10 day training group. The implications of these results are twofold. From a practical perspective, the temporal lag between specific and generalized perceptual learning informs on the development of training protocols for effective use of sensory substitution devices. From a theoretical basis, generalization to the untrained interval suggests that whilst the signal from the device is in essence auditory it is processed in a multimodal manner.

H78

ASSESSING CROSSMODAL INTEGRATION OF AUDITORY AND VISUAL STIMULI IN POSTERIOR SUPERIOR TEMPORAL SULCUS WITH MAGNETOENCEPHALOGRAPHY Jessica Gilbert[1], Ajay Pillai[1], Barry Horwitz[1]; [1]National Institute on Deafness and Other Communication Disorders — Crossmodal integration of auditory and visual stimuli is an important component of perception, with the posterior superior temporal sulcus (pSTS) hypothesized to support this. To test this, we had subjects (N=13) learn 12 abstract, non-linguistic pairs of auditory and visual stimuli over four weeks. These paired associates were of four types: auditory-visual (AV), auditory-auditory (AA), visual-auditory (VA), and visual-visual (VV). At week four, subjects were scanned using magnetoencephalography (MEG) while performing a correct/incorrect judgment on pairs of items. During scanning, subjects were first presented with a learned auditory or visual stimulus (S1), followed by a delay period, then the simultaneous presentation of an auditory and visual stimulus (S2). During S2, the correct paired associate was presented in either the visual or auditory modality on 50% of trials. MEG data were collected at a 600 Hz sampling rate, using a 275-channel whole-head MEG system. Using synthetic aperture magnetometry (SAM), a minimum variance beamformer, we directly contrasted crossmodal (AV and VA) with unimodal (AA and VV) pairs from S2 onset for 2 seconds. Comparisons were made in theta (4-8 Hz), alpha (9-15 Hz), beta (16-30 Hz), and gamma (31-54 Hz) frequencies. We found pSTS showed a significant group-level difference in the beta frequency, with greater desynchronization for crossmodal compared with unimodal trials. Using a sliding window technique, we found the timing of this difference occurred maximally at ~250-750 ms after S2 onset. Thus, these findings support an early role for pSTS in crossmodal integration of auditory and visual stimuli.

H79

EMBODIED AESTHETICS: AUDIOMOTOR REPRESENTATION OF MUSIC IN EXPERTS AND LAYPERSONS. Luca Ticini[1], Giacomo Novembre[1], Florian Waszak[2], Simone Schuetz-Bosbach[1], Peter Keller[1]; [1]Max Planck Institute for Human Cognitive and Brain, Leipzig, [2]Université Paris Descartes & CNRS — Our brain can recognize the actions of others by representing their sounds as a motor event. Previous studies have demonstrated the activation of the listener's motor cortex during passive perception of overfamiliar motor acts, such as the sound of a trained piano performance. Less is known about the embodiment of the sounds of unfamiliar actions. We used music as a model to investigate how the motor system is engaged by passive listening to a piano performance that was unfamiliar and untrained. Transcranial magnetic stimulation (TMS) was employed to measure the correspondence between auditory and motor codes in a group of music experts and a group of laypersons. We compared the corticomotor excitability in response to the presentation of 60 performances of the same melody that differed only in expressive timing (i.e., the subtle temporal nuances introduced by a performer to an otherwise perfectly timed interpretation). Each performance was followed by a question referring to preceding audio (how much participants liked the performance just heard). The findings revealed strongest activation of the motor system to unrehearsed melodies that (i) differed more in expressive timing and (ii) were rated as esthetically pleasing. This activation is common to music experts and laypersons. As such, these findings argue that the human motor system is sensitive to a broader range of features beyond those that are familiar and deepen our understanding on the embodied simulation account of esthetic experience. Funding: Supported by DFG (Schu2471/1-1), ANR (ANR-08-FASHS-13).

H80

HUMAN ELECTROPHYSIOLOGICAL REFLECTIONS OF THE RECRUITMENT OF PERCEPTUAL PROCESSING DURING ACTIONS THAT ENGAGE MEMORY Leanna Cruikshank[1], Jeremy B Caplan[1], Anthony Singhal[1]; [1]University of Alberta — The N170 event-related potential (ERP) component reflects visual perceptual processes and is known to have a source in the lateral occipital cortex (LOC) and temporal lobe regions. Convergent evidence from neuropsychological and neuroimaging studies suggests that the LOC is recruited for action tasks in which visibility of a target is unavailable and perceptual memory must be used instead. We tested whether the N170 reflects the contribution of additional ventral stream processes required for actions in which vision of a target is occluded, predicting that the amplitude of the ERP in the latency range of the N170 would be larger when perceptual mechanisms are engaged to a greater extent. Participants were auditorily cued to touch target dots on a touchscreen. Two viewing conditions varied with respect to the contribution of the ventral stream during response initiation. In condition 1, the target disappeared with movement initiation whereas in condition 2, it disappeared with the cue to respond. The N170 during the initiation phase of trials was larger in amplitude for condition 2. This effect was observed over temporal electrode sites, likely reflecting an overlap between auditory cue-related processes and additional perceptual processes within regions in the inferior-temporal cortex. A second experiment ruled out the possible confound of the offset of the visual stimulus. Thus, the N170 may be a marker of neural activity within the ventral stream, supporting the notion that actions initiated in the absence of a visual target rely more on perceptual representations than those directed towards visually available targets.

H81

EMBODIED AESTHETIC: USING SOMATOSENSORY ERPS AND EXPERTISE TO REVEAL EMBODIMENT MECHANISM DURING AESTHETIC PERCEPTION OF BODY POSTURES Beatriz Calvo-Merino[1,2], Alexander Jones[2], Helge Gillmeister[3], Maria Tziraki[2], Bettina Forster[2]; [1]University Complutense Madrid, Spain., [2]City University London, UK., [3]University of Essex, UK. — Aesthetic processing has recently been associated with an embodiment mechanism. However, the nature of this embodiment is rather unclear. Here we present a somatosensory event-related potential study to explore the neurophysiological correlates of this embodiment during the aesthetic process and how it is modulated by the experience of the observer. EEG was recorded for two groups of participants (18 expert dancers, 18 control non-dancers) during the observation of pairs of body postures while they performed two tasks: (a) an aesthetic preference task, (b) a perceptual task in which the same pairs of body postures were judged for changes in luminance. Moreover, in order to understand if embodiment follows a somatotopic structure, we selected body posture pairs that differed in either upper or lower limb positions. Somatosensory event-related potentials were evoked by tactually stimulating hands and feet using small solenoids while participants performed both

aesthetic and perceptual tasks. Embodiment was measured as the congruency between the body part touched (hands, feet) and the observed body posture limb change (upper, lower limbs). The results showed task differences starting at very early stage of processing (P45, N80), likely in primary somatosensory cortex. Moreover, the expert group showed earlier indicators of embodiment in the aesthetic task than the non-expert group. These results show that different attitudes for seeing (e.g., aesthetic) and acquired sensorimotor expertise modulates sensory responses at a very early stages. Finally, these findings may explain why liking is related to physical sensations and embodiment of an observed piece of art.

H82

THE HANDS HAVE IT: HAND-SPECIFIC VISUAL EVENTS BOOST TOUCH PERCEPTION THE MOST Brenda Malcolm[1], Karen Reilly[2], Jérémie Mattout[3], Roméo Salemme[2], Olivier Bertrand[3], Tony Ro[1], Alessandro Farnè[2]; [1]The City College and Graduate Center of the City University of New York, [2]ImpAct Team, INSERM U1028 - CNRS UMR5292, Lyon Neuroscience Research Center, Lyon 1 University, [3]Brain Dynamics and Cognition Team, INSERM U1028 - CNRS UMR5292, Lyon Neuroscience Research Center, Lyon 1 University — Our ability to accurately discriminate information from one sensory modality is often influenced by information from other sensory modalities. Previous research indicates that tactile perception on the hand may be enhanced if participants look at a hand (compared to a neutral object) and if additional visual information about the origin of touch conveys temporal and/or spatial congruency. The current experiment seeks to further assess the effects of non-informative vision on tactile perception. Participants made speeded discrimination responses to the location (digit 2 or digit 5 of their right hand) of supra-threshold electrocutaneous stimulation while viewing a video showing a pointer, in a static position or moving (dynamic), towards either the same digit of a hand or to the corresponding spatial location on a non-corporeal object (engine). Therefore, besides manipulating whether a visual contact was spatially congruent or incongruent to the simultaneously felt touch, we also manipulated the nature of the recipient object (hand vs. engine). Results showed that dynamic information speeded up RTs, most likely by providing temporal cues about the upcoming touch. Critically, a greater enhancement in tactile discrimination was present when participants viewed a spatially congruent contact compared to a spatially incongruent contact (measured with inverse efficiency scores (IES) to control for possible speed/accuracy tradeoffs). Most importantly, this visually driven improvement was greater for the view-hand condition compared to the view-engine condition. We conclude that tactile perception is enhanced when vision provides non-predictive spatio-temporal cues, and that these effects are specifically boosted when viewing a hand.

H83

EEG CORRELATES OF UNSUPERVISED SPATIAL LEARNING IN IMMERSIVE, LARGE-SCALE VIRTUAL ENVIRONMENTS Markus Plank[1], Joseph Snider[1], Eric Halgren[1], Howard Poizner[1]; [1]University of California San Diego — Humans' ability to generate, modify, and utilize spatial representations in novel environments is crucial for accurate navigation and goal-oriented object interaction. Environmental learning occurs even unsupervised, in the absence of explicit teaching and reward. We were interested in understanding the electrophysiological markers of unsupervised learning and memory in naturalistic, large-scale environments. To this end, we developed an innovative, fully synchronized experimental setup allowing us to record high-density electroencephalography (EEG) and full-body motion capture while subjects were bodily moving within immersive, realistic virtual environments. On the first day of this two-day experiment, subjects actively explored the environment and indicated their interest for uncovered objects on a virtual slider bar ("exploration task"). On the second day, subsets of these objects were swapped, and participants indicated if an object was unchanged or changed ("memory task"). Behaviorally, subjects correctly identified 70 - 95% of the objects. Electrophysiologically, the memory task on day 2 elicited an increased positivity around 230 ms following object encounter over medial frontal regions compared to viewing the objects on day 1, indicating resource-intense attentional allocation for processing object identity and location. Furthermore, the memory task was associated with increased negativity around 450 ms peaking over left-frontal and left-temporal regions. Strikingly, the amplitude of this N400-like component was further increased in centro-parietal and left-temporal areas when subjects encountered object alterations in the environment. This difference most likely indicates distinctive processing when representational expectancies of object-location associations are violated, extending EEG results of studies on semantic congruency to active spatial exploration.

H84

INFERENCES ABOUT FOOD PLEASANTNESS MODULATE ACTIVITY IN THE VENTRAL PALLIDUM. Kristina Rapuano[1], W. Kyle Simmons[1,3], John Ingeholm[1], Nick Knuth[2], Kevin Hall[2], Alex Martin[1]; [1]Laboratory of Brain & Cognition, NIMH/NIH, Bethesda, MD, [2]Laboratory of Biological Modeling, NIDDK/NIH, Bethesda, MD, [3]Laureate Institute for Brain Research, Tulsa, OK — With the recent interest in the neural systems that support food perception and food selection, much translational neuroscience evidence has accumulated demonstrating that activity in the ventral pallidum is associated with the hedonic pleasure linked with ingesting a rewarding food. Efforts to address the growing obesity epidemic, however, will benefit from knowing whether activity in the ventral pallidum also reflects our on-going judgments of the pleasure associated with a particular food prior to eating it. We thus asked subjects to view pictures of foods while undergoing fMRI, and to provide ratings of how pleasant it would be at that moment to eat the food item depicted in the photograph. Ratings were provided via a hand-held scroll wheel by which subjects selected values along a 7-point number line. Echoplanar imaging was conducted with a 3T MRI scanner and an 8-element array of receive-only head surface coils with imaging parameters selected to optimize image quality in the striatum, pallidum, and OFC. We found bilateral regions of the ventral pallidum, as well as the orbitofrontal cortex (OFC), where activity was modulated on an item-by-item basis by subjects' ratings of food pleasantness. These findings demonstrate that individuals' inferences about food pleasantness are related to activity in ventral pallidum and OFC regions known to underlie the hedonic experience associated with ingesting rewarding food. The ventral pallidum may thus be an important target for behavioral and pharmacological interventions aimed at reducing caloric intake by changing how subjects think about foods prior to eating them.

H85

PHANTOMS AND THE BODY SCHEMA: A CASE OF TACTILE AND VISUAL SYNCHIRIA Jared Medina[1,2], Daniel E. Drebing[1,2], H. Branch Coslett[1], Roy H. Hamilton[1]; [1]University of Pennsylvania, [2]Haverford College — After being presented with a stimulus on the ipsilesional side of space, individuals with synchiria report stimulation on the ipsilesional and contralesional side of space. Although most published reports of synchiria are limited to a single modality, we report an individual with a right frontoparietal lesion (KG) who demonstrates both tactile and visual synchiria. We presented KG with a series of tests in order to explore the characteristics of her multisensory deficit. In all experiments, she was asked to report whether a stimulus was presented on the left side, right side, both sides, or not at all. For tactile stimulation, she reported tactile synchiria on approximately 30% of trials. As KG demonstrated tactile synchiria, we were curious if presenting visual stimuli on the body versus off the body would modulate her perception of phantom visual percepts. Furthermore, as she does not report seeing phantoms in everyday life, we also examined the effect of stimulus length on her phantom synchiric percepts. First, we found that KG was significantly more likely to report phantom synchiric percepts when visual stimuli were on her hands (61%) versus off her hands (24%). Furthermore, for stimuli on the hands,

she was significantly more likely to report phantoms for >250 msec stimuli (81%) versus 500-1000 msec stimuli (30%). We discuss these and other results with regards to the interaction between multisensory representations of the body and the functional mechanisms that, when removed, result in synchiria.

H86

LIP READING WITHOUT AWARENESS Emmanuel Guzman-Martinez[1], Laura Ortega[1], Marcia Grabowecky[1], Satoru Suzuki[1,2]; [1]Department of Psychology, Northwestern University, [2]Interdepartmental Neuroscience Program, Northwestern University — Looking at a talking face facilitates speech perception, but this crossmodal effect depends on attention. What about awareness? As recent evidence suggests dissociation between attention and awareness, we determined whether visual influences on speech perception required awareness. The task was to listen to spoken words and to determine as quickly and accurately as possible whether each word indicated a tool. The face of the speaker was concurrently presented. The face either articulated the word that the participant heard (the synchronous condition) or a different word of the same length (the asynchronous condition). The face was either visible or suppressed from awareness using Continuous Flash Suppression where the face was presented to one eye and a strong dynamic mask was presented to the other eye. A dot-detection task was used to ensure that participants attended to the mouth region whether or not the face was visible. A small fraction of the "unaware" trials on which participants saw the face were removed from the analysis. There was no effect of synchronized lip movements on the face-visible trials probably because participants discarded the visual information, which was inconsistent with the auditory words on 50% of the trials. Surprisingly, when the face was invisible, synchronous lip movements (compared to asynchronous lip movements) significantly speeded responses to the target words. This demonstrates that even when a random dynamic mask renders a face invisible, lip movements are still processed by the visual system with high temporal accuracy to facilitate auditory speech perception based on crossmodal synchrony.

H87

AUDIO-VISUAL INTEGRATION IN MID-CHILDHOOD: AN EVENT-RELATED POTENTIALS (ERP) STUDY Natalya Kaganovich[1], Jennifer Schumaker[1], Megan MacPherson[1], Dana Gustafson[1], Danielle Haggard[1], Jihyun Kim[1]; [1]Purdue University — Audio-visual integration plays an important role in child language acquisition, speech-in-noise perception, and long-term memory formation. One measure of efficient audio-visual integration is the ability to differentiate between synchronous and asynchronous events. It is well-established that sensitivity to audio-visual asynchrony is poor in infants compared to adults. However, how it develops throughout childhood is less understood. We examined the ability of 7- and 8-year old typically developing children and college-age adults to discriminate between audio-visually synchronous and asynchronous stimuli. The stimuli consisted of a 2 kHz pure tone and an explosion-shaped red figure. Both stimuli lasted for 200 ms and were presented either alone (figure only or sound only), synchronously, or separated by 100-500 ms, in 100 ms increments. Participants pressed one button if the sound and the figure occurred at the same time, and another button if they did not. Both behavioral and ERP measures were collected. Compared to adults, children were significantly more likely to identify asynchronous stimuli as synchronous when the offsets ranged from 200 to 500 ms, regardless of the order of modalities (visual first or auditory first). Furthermore, adults showed a larger P2 peak amplitude to audio-visually synchronous stimuli compared to the sum of brain responses to auditory only and visual only stimuli, but this P2 enhancement was absent in children. The results indicate that the neural mechanisms underlying audio-visual integration have a protracted developmental course and are not yet mature in school-age children.

H88

DISSECTING THE BODY SCHEMA: TRANSCRANIAL MAGNETIC STIMULATION AND THE TACTILE TEMPORAL ORDER JUDGMENT TASK Shaan Khurshid[1], Jared Medina[1,2], Roy H. Hamilton[1], H. Branch Coslett[1]; [1]University of Pennsylvania, [2]Haverford College — On a tactile temporal order judgment (TOJ) task with the hands crossed, participants will often invert the correct order of stimuli at short ISIs (Yamamoto & Kitazawa, 2002). This and other studies provide evidence that tactile stimuli are first represented in a somatotopic representation agnostic to body position, and then takes into account their position in external space (body posture representation; see Medina & Coslett, 2010). In order to explore functional and neural dissociations in body representations, we presented TMS during a tactile TOJ task. Eight subjects were tested on a tactile TOJ task with the hands uncrossed and crossed before and after 20 minutes of rTMS. Stimulation was presented to left anterior intraparietal sulcus (aIPS, body form) or left Brodmann Area 5 (BA5, body posture) during two sessions. We predicted that TMS to regions involved in representing body form would result in poorer TOJ performance with hands crossed and uncrossed. However, we predicted that TMS of regions involved in representing body posture would disrupt updating of limb position with the hands crossed, resulting in a paradoxical improvement in performance after TMS. Using thresholds derived from adaptive staircase procedures, we found that TMS to left aIPS disrupted TOJ in the uncrossed condition. However, TMS to left BA5 resulted in a substantial improvement in tactile TOJ with the hands crossed when compared to no TMS. These results provide novel evidence for both functional and neural dissociations of the body schema.

H89

RELIEVING A PHANTOM ITCH Elizabeth Seckel[1], Claude Miller[2], Eric Altschuler[3], V.S. Ramachandran[1]; [1]UCSD, [2]UCLA, [3]UMDNJ — Many amputees report experiencing an uncomfortable phantom itch – the perception of an itch relating to a limb that is no longer a part of the body. They are unable to relieve the itch as the phantom limb is not under voluntary control. We have previously shown (Ramachandran and Rogers-Ramachandran, 1996; Altschuler and Scott, 2011) that mirror box therapy using visual feedback may relieve pain present in a phantom limb. We wondered whether similar techniques could be used to relieve a phantom itch. A mirror is placed vertically on a table so that the mirror reflection of the patient's intact lower limb is `superimposed' on the felt position of the phantom. The patient is then instructed to scratch the intact limb where they felt the itch on the phantom. This gave the patient the visual illusion that the phantom itch was also being scratched, which significantly reduced the phantom itch. As a control, subjects repeated the condition with their eyes closed. This invites the idea of a new expansion upon the mirror box therapy technique as many patients report a very uncomfortable phantom itch. Further studies should explore whether mirror visual feedback may reduce an itch in normal subjects.

H90

PERCEPTION AS THE INTEGRAL OF SEMBLANCES FORMED BY RE-ACTIVATION OF EXISTING PREVIOUSLY FORMED FUNCTIONAL LINKS BETWEEN THE POSTSYNAPSES Kunjumon Vadakkan[1]; [1]Division of Neurology, Faculty of Medicine, University of Manitoba — How does firing of a neuron or activation of its synapses impart an internal sensory meaning of perception to the nervous system that it is a part of? An item in the environment can induce simultaneous activation of multiple sensory receptors, similar to associative learning. This induces changes at the locations of convergence of the sensory pathways at higher brain orders such that at a later time point when only one of the sensory inputs arrives, it is capable of inducing semblance of the remaining sensations that arrived with it before. This can be explained by the formation of a functional LINK between postsynapses (postsynaptic membranes), each from different sensory inputs, at locations of their convergence. At a later time point when only one of the sensations arrives at its postsynapse, the functional LINK gets re-activated activating the LINKed postsynapse.

Activation of this second postsynapse without the activation of its presynapse induces a semblance of activity arriving from the latter (Vadakkan KI (2011), Frontiers in Neuroengineering). The sensory identity of this semblance of activity can be extrapolated from the penultimate neuronal orders that lead towards the sensory receptor level. From this, hypothetical packets of sensory inputs that can stimulate the minimum number of sensory receptors to induce the semblance, namely "semblions" are derived. The internal sensation of perception can be viewed as an integral of all the semblions formed and is a function of the previously formed functional LINKs, which in turn is a function of previous associative learning.

PERCEPTION & ACTION: Vision

H91

CROSS-CATEGORY FACE ADAPTATION OF FEATURE ASSOCIATION fengpei hu[1], jing luo[2], duming wang[1], huan hu[1], yiwen wang[1]; [1]Department of psychology, zhejiang sci&tech university, [2]Institute of Microchemistry, Beijing — Prolonged viewing of faces can bias the perception of subsequently viewed faces. A recent study (Ghuman, McDaniel, & Martin, 2010) demonstrated that prolonged viewing of sex-specific body images without faces can also bias the subsequent perception of faces. Here we provided new pieces of evidence for this cross-category aftereffect. Adapting to images of non-face objects with strong gender-specific ties affected subsequent sex judgment of androgynous faces created by morphing between male and female faces. In Experiment 1, we varied the exposure time of the adapting images between 50 and 3200 ms. We found the largest aftereffect when the adapting images were presented for 400 ms. After viewing a female-specific object (e.g., lipstick), participants (n = 12) were more likely to judge a sex ambiguous face as male than in the baseline condition where no adaptor image was presented. In Experiment 2 (n = 12), we explored this cross category aftereffect by using images and words of gender-specific items as adaptors. We replicated the results in Experiment 1 with images of gender-specific items. With words of gender-specific items we found a smaller but significant aftereffect. In Experiment 3, we manipulated the cognitive load of the participants (n = 19) by adding a letter detection task with three levels of difficulty. Increasing cognitive load reduced and eventually eliminated the cross-category aftereffect. In conclusion, the current findings suggest that high-level visual aftereffects can happen when adapting and testing stimuli share connections that are beyond figural similarity.

H92

CLASSIFICATION ACCURACY OF A P300 SPELLER DURING DIFFERENT PERIODS OF EVENT RELATED POTENTIALS. Gunther Krausz[1], Rupert Ortner[1], Christoph Guger[1]; [1]g.tec medical engineering GmbH, Sierningstr. 14, 4521 Schiedlberg, Austria — When talking about Brain-Computer Interface (BCI) controlled spelling devices for disabled people, P300 based systems are the preferred ones, as they provide a high information transfer rate and low training time. In a previous study measurements on 100 subjects were performed, to find out how many people are able to control a P300 based BCI. 8 EEG channels were recorded and each subject performed a 5-character training session followed by a 5-character test session to obtain the individual classification accuracy using a linear discriminant analysis (LDA) classifier. Almost 90% of the participants reached an accuracy of 80 – 100% with the row-column speller. Beneath these results we present the classification accuracy of some single periods of the event related potential such as components occurring around 100 ms, 200 ms and 300 ms after stimulus onset. The data proves that a high spelling accuracy can be achieved with the P300 BCI system, with needing only about 5 minutes of training time. When looking at specific periods it is not surprising that the component around 300 ms is best suitable for discriminating between target and non-target stimuli, although for "bad performers" a window around 200 ms delivers even a higher accuracy. These findings underline the importance of the N200 component for the spelling-BCI as it reflects both, involuntary visual processing and conscious attention.

H93

OCULOMOTOR DEFICIT IN PATIENTS WITH BASAL GANGLIA LESION Bridget Andrews[1], Giovanni d'Avossa[1], Ayelet Sapir[1]; [1]Bangor University — Stroke patients often show slow saccadic reaction time (SRT) towards contralesional targets. This could be due to difficulty in target detection or in planning and executing the saccade itself. Thirteen chronic stroke patients (seven with a right hemisphere lesion) with unilateral cortical and subcortical lesions, and twelve healthy control participants completed a pro- and anti-saccade task to assess their perceptual and oculomotor deficits. Participants viewed two white circular place holders either side of central fixation cross, while at random intervals one of them would become green (pro-saccade target) or red (anti-saccade target). Participants moved their eyes toward the green target and away from the red target toward the opposite place holder, while an eye-tracker recorded their eyes. The anti-saccade condition enabled us to dissociate between perceptual and oculomotor deficits, as slow SRT following an ipsilesional red target (requiring a contralesional eye movement) would indicate an oculomotor deficit, while a slow SRT following a contralesional red target (requiring an ipsilesional eye movement) would indicate a perceptual deficit. Three patients were slow to execute contralesional saccades in both the pro- and anti-saccade conditions, showing an oculomotor deficit. These patients were the only patients to have lesions in the basal ganglia while none of the other patients with lesions elsewhere showed the same deficit. We conclude that lesions in the basal ganglia lead to a deficit in planning and executing eye movements toward contralesional stimuli. These results support recent findings associating the basal ganglia with directional hypokinesia in neglect patients.

H94

THE NEURAL CORRELATES OF FEEDBACK INFORMATION PROCESSING IN VISUAL CATEGORY LEARNING TASKS Rubi Hammer[1], Vladimir Sloutsky[2], Kalanit Grill-Spector[1]; [1]Department of psychology, Stanford University, [2]Center for Cognitive Science and Department of psychology, The Ohio State University — Visual Category Learning (VCL) is a fundamental cognitive capacity that has been reported to involve multiple neural systems in the human brain. To date the respective role of these neural systems and the way they interact in VCL tasks is not well understood. In order to determine the neural mechanisms involved in processing feedback information necessary to disambiguate a categorization rule, we scanned participants while they performed both supervised and unsupervised VCL tasks where informative trial-by-trial feedback was provided only in supervised VCL tasks. For each task we used a distinct novel creature-like stimuli in which stimuli differed from one another across several feature-dimensions (e.g. body shape, limbs size, tail length…), yet only one feature-dimension was important for determining the category identity among one of two subcategories. This design mimicked the expected ambiguity one experiences when introduced with novel natural-like objects. Each learning trial was composed of three sequential events – stimuli presentation, response via key press, and feedback processing. This allowed disassociating the neural correlates of these VCL components. Our data show higher neural activity associated with negative feedback (as compared with positive feedback) in the intraparietal sulcus, anterior cingulate, frontopolar, ventrolateral and premotor cortices. This finding suggests that brain processing of informative negative feedback which leads to performance improvement involves coupling between neural activity in brain regions involved in error detection and conflict management (anterior cingulate) as well as cognitive control (frontopolar; ventrolateral), with regions associated with visuospatial processing (intraparietal sulcus) and response execution (premotor cortex).

H95

OBJECT-BASED ATTENTIONAL MODULATION OF EFFECTIVE CONNECTIVITY IN BIOLOGICAL MOTION PERCEPTION Ashley Safford[1], Kristine Siembieda[1], James Thompson[1]; [1]George Mason University — The ability to recognize and understand the movements and actions of others is critical to effective social interaction. The role that selective attention may play in modulating the brain regions involved in processing these complex stimuli is unclear. To better characterize this relationship, here, we combined event-related fMRI and dynamic causal modeling (DCM) to examine task-related changes in effective connectivity between attention control areas and cortical areas that show object-motion category-specific responses. Eighteen participants attended to point-light animations of either human or tool motion that were spatially overlapping with either intact or scrambled versions of the other motion type. fMRI results showed object-category responses in the lateral temporal cortex; bilateral superior temporal sulcus (STS) responded more strongly to biological motion, while left inferior temporal gyrus (ITG) showed a greater response to tool motion. Importantly, these category responses were modulated by attention such that directing attention to tool motion reduced responses in STS. The superior parietal lobule (SPL) and middle temporal gyrus (MTG) showed greater response to overlapping intact stimuli, reflecting increased attention. Random effects group analysis comparing 24 DCM models with family level inference support a model in which visual information enters the network through MTG; following this initial object motion processing step, category selective regions (ITG/STS) are modulated by top-down and bottom-up influences from SPL and MTG based on task-attention conditions. These results highlight the important role of top-down influences on cortical regions selective for biological and tool motion.

H96

ISOLATING THE RIPPLES OF RECOGNITION WITHIN STIMULUS-DRIVEN SSVEP WAVES: TOPOGRAPHIC INSIGHTS INTO WORD AND FACE IDENTITY PROCESSING Yuliya Yoncheva[1], Zachariah Reagh[1,2], Bruce McCandliss[1]; [1]Vanderbilt University, [2]University of Alabama at Birmingham — Steady-state visual evoked potentials (SSVEPs) are resonant oscillatory EEG responses to repetitive stimulation. While it has been demonstrated that low-level perceptual and attentional processes can modulate SSVEP power, it remains unknown whether SSVEPs exhibit sensitivity to higher-level categorization processes such as word recognition. To investigate this question, we induced a novel EEG frequency related specifically to higher-level processes, independent of stimulus oscillation rate. Category specificity was indexed by shifts in SSVEP topography for recognizing words versus faces. High-density EEG was recorded while sixteen adults detected occasional targets within blocks of word or face stimuli, each presented at a constant frame-update rate of 7.5 Hz. Identity-update rate was manipulated: in the control condition, each stimulus represented a unique face or word at a unique location; in the experimental condition, stimulus identity was updated only once every three frames (2.5 Hz). Power increases emerged at the identity-update rate and its harmonic for words and faces, indicative of an oscillation relevant to stimulus identification. This effect was category-specific (whole-map topographic ANOVA $p<.05$). Notably, the topography of identity-update harmonic revealed differential power over left versus right visual cortex ($p<.05$): oscillating words produced a more left-lateralized response relative to oscillating faces. This pattern is consistent with the engagement of left-lateralized networks in early perception of linguistic information. These findings demonstrate that higher-level mechanisms encoding categories, e.g., words and faces, can induce new frequencies in the SSVEP, independent of stimulus presentation rate, and thus offer a novel tool for studying face perception and reading development.

H97

THE ROLE OF SPATIAL FREQUENCY IN OBJECT RECOGNITION: EVIDENCE FROM BACKWARD MASKING AND FMRI Anat Fintzi[1], Brittany Eltman[2], Bradford Z. Mahon[1]; [1]University of Rochester, [2]Messiah College — Previous research shows that mid-to-high spatial frequencies (SF) are critical for face recognition. We conduct two experiments, one behavioral (Exp 1) and one using functional Magnetic Resonance Imaging (fMRI; Exp 2), to study the role of different SF bands in supporting recognition of a broader range of categories: tools, places, animals, and faces. Experiment 1 used a backward masking paradigm where participants made living/nonliving decisions on visible targets preceded by masked primes. Prime images were identical to targets and were scrambled or band-passed filtered (width = 1.32 octaves, range = .17 to 11.1 cycles per degree). Mid-to-high band-pass primes (2.12 to 4.87 cycles per degree) elicited the fastest response times for target categorization across all categories, indicating that a relatively narrow range of SF is critical for object recognition. In Experiment 2, two-minute movies were created in which a given picture (tools and animals) transitioned from low SF to high SF, or the reverse. Critically, only a narrow range of SF (width = 1.2 octaves) was present at any given moment. Participants free-viewed the movies during fMRI scanning. We used phase-lag analyses to create whole brain maps of continuous variation in BOLD preferences of different SF ranges. Results show that activation in the ventral object-processing stream is most highly correlated with mid-to-high SF information for tools and animals. This is consistent with Experiment 1, where mid-to-high SFs elicited the strongest semantic priming across categories. Results of both experiments are discussed in the context of current models of visual object recognition.

H98

IF YOU LOOK HAPPY, YOU LOOK FEMALE: STEREOTYPICAL BIAS IN FACE AFTER-EFFECTS Fika Karnadewi[1], Derek H. Arnold[1], Ottmar V. Lipp[1]; [1]University of Queensland — Exposure to a human face can induce a 'face after-effect', wherein the appearance of a subsequent face is altered. Exposure to a male face, for instance, can make a subsequent androgynous face look more female. Investigations of these effects, to date, have been bound within a single categorical dimension, such as gender, race, or emotion. Processing each of these categorical dimensions has been shown to map onto separate neural networks (e.g., Haxby et al., 2000). The multidimensional nature of facial coding, however, allows for interactions between distinct facial characteristics. For instance, male faces adopting neutral expressions are more often judged as angry than are female faces, and androgynous happy faces are more often judged as female than male. In Experiment 1 we replicated these subjective relationships. We then examined if these relationships would impact face after-effects via face adaptation test. We found that adapting to male and female faces adopting neutral expressions produced an after-effect when judging the facial expressions of androgynous faces (Exp2). Similarly, exposure to androgynous faces adopting angry and happy expressions produced an after-effect when judging gender (Exp3). These results show that the interdependence of gender and emotional expression impacts the processes responsible for generating face after-effects. These data suggest that face after-effects could be used to identify independent and interdependent facial characteristics.

H99

REDUCED OCULOMOTOR INHIBITION WITH INCREASED VISUAL WORKING MEMORY LOAD Keisha Notice[1], Ian van der Linde[1], Shahina Pardhan[1], Peter Bright[1]; [1]Anglia Ruskin University, Cambridge, UK — Oculomotor inhibition in the retinotopic neuronal map of the superior colliculus results in saccadic eye movements deviating away from covertly attended objects. Saccades have also been shown to deviate away from the locations of remembered objects in peripheral vision (e.g., Theeuwes et al., 2005). Using a dual-task paradigm, this study, comprising three counterbalanced conditions, examined the extent to which visual working memory (VWM) influences saccadic deviation. In condition 1 (sac-

cade paradigm) participants executed eye movements from a fixation cross towards a target stimulus following a briefly presented (500ms) peripheral distractor. In condition 2 (VWM paradigm) participants performed a 2-interval yes/no recognition memory task for a single Gabor test stimulus following a three Gabor 1500ms memory display. Condition 3 (dual-task paradigm) combined conditions 1 and 2. In condition 3, participants expressed significantly reduced saccadic deviation (measured as the mean angle of saccade trajectory) for distractors in close proximity to a target in comparison to condition 1, and a poorer recognition memory performance in comparison to condition 2. These results suggest that when VWM is loaded, as evidenced by reduced memory performance, the inhibition of neurons used in saccade programming is reduced. These findings highlight the need to re-examine current saccade programming theory that, as yet, only accounts for attentional mechanisms. Our data indicates that VWM serves to suppress distracting information in peripheral vision during the preparation of visually guided saccades. Goal-directed suppression of irrelevant information is reduced when the availability of VWM is limited due to increased task demands.

H100

BIASES IN SPATIAL PERCEPTION REFLECT PATTERNS OF LEXICALIZATION Alexander Kranjec[1], Gary Lupyan[2], Anjan Chatterjee[3]; [1]Duquesne University, [2]University of Wisconsin-Madison, [3]University of Pennsylvania — We show that biases in the visual perception of spatial relations reflect patterns of lexicalization. Kosslyn (1987) originally proposed a hemispheric bias for processing two types of spatial information. Categorical information refers to spatial relations that are discrete, abstract, and commonly lexicalized by locative prepositions like above, below, left, and right. More fine-grained coordinate information pertaining to metric distance relations is continuous and less amenable to lexicalization. In the present experiment, participants made same/different judgments on pairs of dot-cross configurations presented simultaneously for 200ms to the left and right of central fixation. Pairs could be different with respect to either their categorical or coordinate relations. For CATEGORICAL trials, dots were located in different quadrants the same distance from the center of each cross; for COORDINATE trials, dots were located in the same quadrant at different distances from the center of each cross. The orientation of the crosses was also manipulated. In AMBIGUOUS trials, crosses were composed of intersecting vertical and horizontal lines forming a "+" shape. In UNAMBIGUOUS trials, both crosses were rotated 45° to form an "×" shape such that the quadrants were now unambiguously associated with easy-to-name verbal spatial categories (above/below/left/right). Results demonstrate that discriminating categorical spatial relations between easy-to-name categories is easier than between more ambiguously-named categories; conversely, discriminating coordinate spatial relations within an easy-to-name category is actually more difficult than within a more ambiguously-named category. These results suggest that lexicalized categories can modulate the perception of spatial relations even for coordinate information.

Tuesday, April 3, 3:00 - 5:00 pm, Exhibit Hall

EMOTION & SOCIAL: Emotion-cognition interactions

I2

ELECTRICAL STIMULATION ABOLISHES THE ELICITATION OF SCHADENFREUDE DURING VICARIOUS LEARNING ON THE IOWA GAMBLING TASK Caroline Bowman[1], Alys Griffiths[1], Andrew Dawson[1], Oliver Turnbull[1]; [1]Bangor University, Wales, U.K. — Schadenfreude (experiencing pleasure at the misfortune of another) in response to emotional feelings provoked by inequality, or envy of others, has been shown to lead to inappropriate learning in observers of same-sex friends playing the Iowa Gambling Task (IGT; Turnbull, Worsey & Bowman, 2007). To investigate whether the manifestation of schadenfreude was resultant from the nature of abstract punishment (loss of money), or explicit punishment, aversive electrical stimulation was administered to Players when they received the heaviest financial penalties on the IGT. Sixty-eight participants were tested in pairs of same-sex friends, either with or without electrical stimulation being administered to the Player as they performed the IGT. Observers passively watched play, and then performed themselves, in the absence of electrical stimulation. Results demonstrated that the use of electrical stimulation as an explicit punishment enhanced early, but not late, performance on the IGT in Players. Further, results showed that Observers who witnessed explicit punishment performed advantageously on the IGT, but those who observed play in the absence of electrical stimulation, performed disadvantageously on the IGT. These results add to previous findings that suggest, somewhat paradoxically, that the experience of schadenfreude debilitates rather than facilitates future decision-making behaviour. Furthermore, although much research investigates the nature of schadenfreude amongst intergroup rivals, these findings provide important insight into the boundary conditions that elicit schadenfreude within intra-group relationships.

I3

MULTIPLE OXYTOCIN RECEPTOR POLYMORPHISMS ARE ASSOCIATED WITH CHARITABLE BEHAVIORS IN EVERYDAY LIFE Laura Beavin[1], Jorge Barraza[1], Paul Zak[1]; [1]Claremont Graduate University, Center for Neuroeconomic Studies — Recent evidence links various oxytocin receptor single nucleotide polymorphisms (SNPs) to positive social traits and performance in lab-based social decision tasks. The goal of the study was to investigate whether charitable giving, as measured by self-report and in a lab-based donation task, vary across oxytocin receptor alleles of rs2254298, rs53576, rs237887, and rs2268490. Results demonstrated that individuals homozygous for the A allele in the rs237887 SNP reported donating a larger amount compared to those with at least one copy of the G allele. There was also an effect of rs53576 genotype, with AA individuals having donated a larger percent of their income than those with at least one copy of the G allele. Moreover, rs53576 was linked to religious giving, such that those with the AA or AG genotype gave more for religious purposes than individuals homozygous for G. Further analyses indicated that this relationship was mediated by self-reported religious commitment. For the lab donation task, the distribution of individuals who chose to donate varied across genotypes of the rs237887 and rs2268490 SNPs, with a larger percentage of individuals who were heterozygous for A and C, respectively, making donations. The same group of individuals with the CC genotype for rs2268490 also donated a larger dollar amount in this task. This study demonstrates the presence of a genetic component in laboratory based and real world charitable behaviors.

I4

IMPAIRED IDENTIFICATION OF FACIAL EXPRESSIONS OF FEAR IN IRAQ WAR VETERANS WITH PTSD AND MTBI Victoria Ashley[1], Jary Larsen[2], Nikki Pratt[1], Diane Swick[1,2]; [1]University of California, Davis, [2]Veterans Affairs Northern California Health Care System — Studies suggest that patients with post-traumatic stress disorder (PTSD) process emotional facial expressions differently then healthy individuals; PTSD patients display exaggerated amygdala and diminished prefrontal cortex responses to fearful facial expressions. A recent study also found specific accuracy impairments and decreased sensitivity in recognizing expressions of fear and sadness in war veterans with PTSD (Poljac et al., 2011). To assess the role of PTSD in facial expression recognition, we showed pictures of faces to Iraq war veterans with PTSD and mild traumatic brain injury (mTBI), and to healthy age-matched military controls, and asked them to identify the expressions. A total of 140 faces (Ekman & Friesen, 1976) were presented in black and white, one at a time, in pseudo-randomized order. Faces had one of six basic expressions (happy, angry, fear, surprise sad, disgust) or neutral, with half of the expressions at 100% full intensity and the other half at 50% intensity made by morphing expressions with neutral (Calder, et al., 1996). Preliminary results suggest that, like Poljac et al. (2011), PTSD patients show impaired accuracy at identifying 50% intensity fear faces, relative to military controls ($p<.05$; Accuracy: patients=38%, controls=51%) and display a trend for impaired accuracy for full intensity fear faces ($p<.06$). PTSD patients also show a trend for misidentifying fear as surprise ($p<.1$). Our study did not find impairments on expressions of sadness, but is consistent with a growing body of research indicating altered processing of fearful facial expressions in PTSD (Poljac et al., 2011; Beevers et al., 2011).

I5

AN EXPECTANCY BIAS FOR AVERSIVE EVENTS: THE ROLE OF AROUSAL AND AWARENESS Julian Wiemer[1], Paul Pauli[1]; [1]University of Würzburg — The tendency to associate fear-relevant stimuli with aversive consequences was shown to be correlated with the perceived aversiveness of electrical shocks after fear-relevant stimuli. In the present study we investigated how the aversiveness per se affects the expectancy of events. If expectancies are guided by an adaptive conservatism, highly aversive events should rather be expected than less aversive events. Participants attended to three types of neutral colored visual stimuli. Each stimulus color was associated with a different level of loudness of an acoustic startle probe (95dB, 100dB, 105dB). We measured online expectancy of these tones and pupil diameter as a measure of sympathetic

arousal. Although the probability of a startle probe was always 50%, expectancy ratings were enhanced for the loudest tones. There were no differences between the visual cues in terms of arousal ratings and pupil diameter, indicating that the effect was not mediated by differential arousal. After the experiment we asked the participants whether they noticed the association between visual cues and aversiveness of the tone. The illusory correlation between aversiveness and occurrence was still significant for those who were not aware of this association. The results imply that humans' expectancies of aversive events are guided by an adaptive conservatism that works so effectively that the awareness of the aversiveness is not a prerequisite. This cognitive bias could be a sustaining factor of anxiety disorders.

I6

BRAIN PATHWAYS UNDERLYING COMPASSIONATE ACTION Yoni Ashar[1], Jessica R. Andrews-Hanna[1], Nicholas W. Peterson[1], Brandin Williams[1], Tal Yarkoni[1], Sona Dimidjian[1], Tor D. Wager[1]; [1]University of Colorado, Boulder — Compassion is a cornerstone of individual well-being and a well-functioning society. In this work, we are developing a model of compassionate action, operationalized as decisions to give money to others in need, at both psychological and brain systems levels of analysis. Using factor analysis, we dissect the predictors of charitable donation into several affective components, such as feelings of closeness/empathy and personal distress, and several cognitive components, including attributions of responsibility and perceived instrumentality of the donation in helping. Each of these factors independently predicts how much a person will give to a recipient, but controlling for these factors, perceived similarity to the recipient is not predictive. Our current work maps these affective and social cognitive factors onto brain circuits, focusing on a) distinctions between areas of the medial prefrontal cortex thought to track affiliative feelings and social cognitive judgments, and b) distributed systems thought to track the giver's subjective emotional distress.

I7

STRESS EFFECTS ON REINFORCEMENT LEARNING IN YOUNGER AND OLDER WOMEN: AN FMRI INVESTIGATION Nichole Lighthall[1], Lin Nga[1], Alex Ycaza[1], Jung Jang[1], Ricardo Velasco[1], Mara Mather[1]; [1]University of Southern California — Stress is common in everyday life and appears to alter learning and decision making involving potential rewards and punishments. This finding that may be attributed to stress-induced enhancements of dopamine system activity. Due to age-related changes to brain structure and function, however, the impact of stress is likely to differ for younger and older adults. The present study used functional neuroimaging to investigate acute stress effects on brain activation during a reinforcement learning task that included positive and negative social feedback. The current study also examined whether stress effects on reinforcement learning and related brain activation differed by age, by comparing healthy younger (age 18-35) and older (age 60-77) women. The cold pressor task was used to induce a neurophysiological stress response. After a delay to align the learning task with hypothalamic-pituitary-adrenal axis response to the stress, participants completed a feedback-based probabilistic learning task during functional magnetic resonance imaging. The goal of the task was to maximize positive feedback and minimize negative by using trial and error to determine the outcomes associated with several novel stimuli in choice pairs. Neural response to reinforcer-associated stimuli, prediction error, and feedback will be determined. Salivary cortisol levels will be used as a measure of hypothalamic-pituitary-adrenal axis reactivity to stress. Older participants appeared to learn better from social reward than punishment, but stress reduced this valence bias. In addition, stress effects on task-related brain activation were more pronounced in older participants. These findings indicate that stress effects on reinforcement learning depend on age.

I8

ALTERNATING BIGENDER: A NOVEL CONDITION SHEDS LIGHT ON THE PLASTICITY OF SEX AND GENDER Laura Case[1], Vilayanur Ramachandran[1]; [1]Center for Brain and Cognition, University of California San Diego — Between the two extreme ends of human sexuality – male and female – lie a poorly understood spectrum of sexual identities that are very much a part of the human condition but defy rigid classification. “Bigender” is a recently formed sub-category of transgenderism, describing individuals who experience a blending or alternation of gender states. To date, no scientific work has addressed this fascinating condition, or proposed any physiological basis for it. We present the results of a survey of 30 bigender individuals indicating that many of them experience an involuntary switching of gender states. In addition, similar to transsexual individuals, the majority of bigender individuals experience phantom breasts or genitalia corresponding to the non-biologic gender when they are in a trans-gender state. Finally, our survey found decreased lateralization of handedness in the bigender community. These observations and others suggest a biologic basis of bigenderism and lead us to propose a novel gender condition, “Alternating Gender Identity” (AGI). We hypothesize that AGI may be related to an unusual degree or depth of hemispheric switching and corresponding callosal suppression of sex appropriate maps in parietal cortex- possibly the superior parietal lobule- and its reciprocal connections with the insula and hypothalamus. We are currently exploring cognitive and hormonal differences in bigender individuals across male and female states. By providing a case of sharp brain-sex shifts within individuals, we believe that the study of AGI could prove illuminating to scientific understanding of gender, body representation, and the nature of self.

I9

ANXIETY AFFECTS VISUAL PERIMETRY Caroline Crump[1], Andrea Wong[2], Eran Zaidel[1]; [1]University of California, Los Angeles, [2]Southern California College of Optometry — Anxiety is known to be associated with changes in processing higher cognitive functions involving emotional stimuli (e.g., Ferneyhough, Stanley, Phelps, & Carrasco, 2010; Bocanegra & Zeelenberg, 2009), but few studies examined the effects of anxiety on low-level perceptual processes of non-emotional stimuli. In this experiment, we asked whether anxiety affects simple visual perimetry; namely the ability to detect spots of light in the periphery of the visual field. We assessed anxiety level using the trait portion of the State-Trait Anxiety Inventory (Spielberger et al, 1983) in 35 undergraduate participants. Participants then completed a modified version of a standard perimetry test, detecting a small dot of light 13 cd/m² at a visual angle of 8°, 14°, 20°, and 26° from fixation. High anxiety resulted in two separate effects on perception: first, individuals with high anxiety showed an increase in sensitivity to the center of their vision, reflecting increased attention to that region. Second, individuals with high anxiety set a more conservative criterion for target detection, reflecting a more conservative decision threshold. Our results suggest a simple diagnostic test for anxiety that does not involve emotional stimuli. Our results also suggest that care should be taken to account for the emotional condition of the participant even in simple perceptual tests.

I10

DOMAIN-SPECIFIC NEURAL DIFFERENCES IN ADOLESCENTS WITH BIPOLAR DISORDER, ADHD, AND BIPOLAR COMBINED WITH ADHD IN A STOP SIGNAL TASK James Ellis[1], Alessandra Passarotti[1], Ezra Wegbreit[1], Mani Pavuluri[1]; [1]Pediatric BRAIN Center, Institute for Juvenile Research, Department of Psychiatry, University of Illinois at Chicago — The goal of this study was to elucidate the neural correlates of response inhibition processes between adolescent patients with common symptoms of poor attention, impulsivity, and poor inhibition, but different diagnoses, namely pediatric bipolar disorder (PBD), ADHD, and PBD with ADHD. Thirty-one acutely-ill adolescents with PBD (mean age±SD; 13.9±2.5), twenty-one adolescents with ADHD (13.2±2.3), twenty-four adolescents with comorbid PBD/ADHD diagnosis (13.8±1.9), all un-medicated, and

thirty-three typically developing healthy controls (HC) (14.2±2.8) were scanned while performing a Stop Signal Task. The groups did not differ significantly in accuracy. Whole-brain analyses revealed that on Stop trials where all subjects correctly withheld a response, PBD subjects demonstrated greater activation compared to ADHD subjects in the left ventrolateral prefrontal cortex (VLPFC), and more activation compared to comorbid subjects in left parahippocampal regions. HC exhibited greater activation in bilateral temporal regions compared to all other groups. On Stop trials where all subjects incorrectly responded, group differences were found in the left middle frontal gyrus, where ADHD and PBD subjects exhibited greater activation than HC. In this condition, HC demonstrated heightened activation of the superior temporal sulcus/BA41 compared to the patient groups. For correct versus incorrect Stop trials, the patient groups, relative to HC, showed decreased activation of the putamen. Our findings suggest important neural differences in the patient groups in regions involved with response inhibition, such as the VLPFC and putamen. This is one of the first studies to test for and find neural differences in symptomatically overlapping pediatric illnesses such as PBD and ADHD.

I11

NEURAL REGIONS RECRUITED DURING IMPROVED EMOTION REGULATION ABILITY IN PATIENTS WITH BORDERLINE PERSONALITY DISORDER BEFORE AND AFTER TREATMENT. Jocelyn Shu[1], Jennifer A. Silvers[1], Hedy Kober[2], Emily A. Biggs[3], Amanda Carson-Wong[4], Eric Fertuck[1,3], Jochen Weber[1], Barbara Stanley[1,3], Kevin N. Ochsner[1]; [1]Columbia University, [2]Yale University, [3]New York State Psychiatric Institute, [4]Rutgers University — Borderline personality disorder (BPD) is characterized by unstable emotional experiences and deficits in emotion regulation abilities. Assessing changes in emotion regulation capacity as a function of treatment may be a useful means for evaluating the efficacy of different interventions. The present study sought to examine changes in emotion regulation ability as assessed by a cognitive reappraisal task before and after six months of treatment (Dialectical behavioral therapy or fluoxetine medication). Thirteen women diagnosed with BPD were scanned at two time points on a task that involved reappraising memories of aversive events in their lives. Participants were asked to recall eight aversive memories and were cued to think about them with an immersed, emotional perspective or an objective, distanced perspective. During the pre-treatment and post-treatment scans, participants reported greater negative affect when recalling memories from the immersed perspective and demonstrated the capacity to decrease negative affect when taking the distanced perspective. However, after receiving treatment for six months, participants showed a greater ability to down-regulate negative emotions while thinking about memories from a distanced perspective. The ventromedial prefrontal cortex (VMPFC) was amongst the neural regions recruited during improved emotion regulation ability while thinking about memories from a distanced perspective in the post-treatment scan. VMPFC has been implicated in mood and affective disorders as well as in the regulation of negative affect. These findings suggest that VMPFC may play an important role in the mechanisms that underlie improvements in emotion regulation ability stemming from treatment.

I12

THE INFLUENCE OF EXECUTIVE FUNCTIONS ON EMOTIONAL PROCESSING Alana Campbell[1], Deana Davalos[1]; [1]Colorado State University — Affective processing interacts with many cognitive processes; emotionally salient information is better remembered (LaBar & Phelps, 1998) and cognitive strategies can modify emotional responses like fear and reward. Less is known about how emotional processing interacts with executive functions. This study seeks to understand this interaction. To do this, participants had their brainwaves recorded while completing a modified working memory task, the delayed matching to sample task. The task presented participants with sample and target emotional images taken from the International Affective Picture System and were positive, neutral or negative in valence. A sample emotional image was presented followed by a delay during which the sample image was to be maintained. Finally, a comparison emotional image was presented whose emotionality was either congruent or incongruent to that of the sample image. Emotional responses to the comparison image were recorded both behaviorally and electrophysiologically, as measured by the late positive potential (LPP). The amplitude of the LPP is an indicator of change in neuronal activity and can be compared across types of stimuli. We found that the amplitude of the LPP waves in response to the comparison images that were emotionally congruent to the sample were accentuated, while those that were incongruent were attenuated. This suggests that we are able to selectively modify our emotional responses.

I13

OUTCOME ASSOCIATIONS INDUCE EARLY EFFECTS IN ERPS Annekathrin Schacht[1], Nele Adler[2], Peiyao Chen[3], Taomei Guo[4], Werner Sommer[3]; [1]University of Goettingen, [2]Humboldt-Universität zu Berlin, [3]Pennsylvania State University, [4]Beijing Normal University — Emotional pictures, faces, or words elicit an early posterior negativity (EPN) in the event-related potential, starting around 200–400 ms, followed by a late positive complex (LPC). Occasionally, also very early effects of emotion (VEEEs) are seen prior to 200 ms. The present study examined whether VEEEs can be due to direct links established by reinforcement learning. In the learning session, participants learned to associate previously unknown Chinese words with monetary gain, loss, or neither. In the test session, they were required to distinguish the learned stimuli from novel distracters. Specific to stimuli associated with positive outcome a VEEE, consisting of a posterior positivity, appeared around 150 ms and an LPC between 550 and 700 ms, whereas an EPN was absent. These results show that previous association with reward can induce VEEEs, indicating that emotion effects in ERPs may arise in the absence of biologically preparedness and semantic meaning.

I14

THE LEAN AND THE RICH SIDE OF EMOTIONS. DISSOCIATED INSULAR AND TEMPORO-PARIETAL PATTERNS IN AFFECTIVE THEORY OF MIND TASK Corrado Corradi-Dell'Acqua[1,2], Christoph Hofstetter[1,2], Patrik Vuilleumier[1,2]; [1]Swiss Centre for Affective Sciences, University of Geneva, Geneva, Switzerland, [2]Laboratory for Neurology and Imaging of Cognition, Department of Neurosciences and Clinic of Neurology, University Medical Center, Geneva, Switzerland — Studies investigating the neural substrates for understanding others' emotions suggest an involvement of temporo-parietal and medio-prefrontal regions whose role is often interpreted in "mentalistic" terms", that is, as a recruitment of more general processes involved in assessing others' mental states. We carried out an fMRI study in 46 female volounteers and used multivoxel pattern analysis to test whether, in these regions, the activation patterns coding for people's affective states overlapped with those triggered by traditional theory-of-mind tasks. We found that in the temporo-parietal junction (bilaterally) and in the precuneus there was a strong pattern overlap between the responses associated with assessing others' emotions and beliefs (but not others' pain). This was not the case of the medial prefrontal cortex which exhibited increased neural activity when assessing both beliefs and emotions, although there was no evidence for a unique activation pattern behind these responses. Finally, the left insula cortex exhibited a pattern overlap between the activation associated with assessing others' emotions and pain (but not beliefs), thus suggesting that the neural underpinnings underlying evaluating others' emotions are not exclusively mentalizing-related. Our data provides strong evidence that in the temporo-parietal junction, but not in the medial prefrontal cortex, the neural responses underlying mentalizing are also recruited when inferring others' affective states.

I15

EXPECTATION OF EMOTIONAL STIMULI ENHANCE PERCEPTUAL DECISIONS Tamara Sussman[1], Aprajita Mohanty[1], Akos Szekely[1]; [1]Stony Brook University — Prioritized perceptual processing of emotional compared to neutral stimuli may account for faster responses to emotional stimuli; however, the mechanisms involved remain unclear. According to the "predictive coding" hypothesis, the brain generates predictive codes or templates prior to stimulus encounter, resulting in greater speed and accuracy of subsequent perceptual judgments. Drawing from this hypothesis, we examined if expectation of, rather than encounter with, an emotional stimuli is critical in its enhanced perception. We determined each participant's perceptual threshold (75% correct) by presenting degraded angry (AF) and neutral faces (NF) in a two-alternative forced-choice task. Subsequently, AF or NF were presented at this threshold following predictive cues while subjects indicated the presence of AF or NF. Results show that perceptual sensitivity (d') is greater for AF following angry cues versus NF following neutral cues, $t(11)=2.44$, $p<.05$. Furthermore, detection of AF following angry cues was faster than NF following neutral cues, $t(11)=-3.05$, $p<.05$. Therefore, expectation of emotional stimuli results in faster and more accurate detection. Using fMRI and multivariate pattern analyses (MVPA), we expect that cue-related ensemble activity patterns in ventromedial prefrontal cortex will reflect the target stimulus prior to stimulus onset, while the amygdala does so only for the angry targets. Activity patterns in the fusiform face area will reflect the target stimulus before and after stimulus onset with stronger pre-post ensemble pattern correlations for emotional stimuli which will also predict improved d'. Overall, findings from this study will highlight the psychological and neural mechanisms underlying perceptual prioritization of emotional stimuli.

EMOTION & SOCIAL: Person perception

I16

FIRST IMPRESSION MATTERS: THE INFLUENCE OF INITIAL IMPRESSION ON REVERSAL LEARNING Yeonsoon Shin[1], Hackjin Kim[2], Hye-young Kim[1], Sanghoon Han[1]; [1]Yonsei University, Seoul, Korea, [2]Korea University, Seoul, Korea — Although an impression such as extraversion, one of the big five personality traits, can be formed rapidly even at neutral faces, a caveat of rapid impression is its inaccuracy. Given that people tend to learn and update the actual personality trait as experience with the person accumulates, the reversal learning often plays a more fundamental role in an impression formation during person perception. With a model-based functional magnetic resonance imaging (fMRI), we examined neural substrates of an impression reversal learning and an effect of perceived initial trait on it. We scanned a prediction task during which participants made guesses about whether the target face, who was initially judged introverted or extraverted, would perform the presented activities, either introverted or outgoing. Participants were provided with trial-by-trial feedback indicating whether the target person had preferred extraverted activities or introverted ones. The behavioral result reliably indicated that the initial impression of Introverted is more sluggishly reversed to Extraverted (IE) than Extraverted to Introverted (EI). Our model-based fMRI results with temporal difference learning model revealed activation in nucleus accumbens, ventromedial prefrontal cortex, and hippocampal/parahippocampal regions as a function of prediction error fitted at feedback events for IE reversal. In contrast, for EI reversal, insula, fusiform gyrus, medial prefrontal cortex, and parietal lobe were activated. Along expected value signals at face presentation, dorsal striatum showed an interaction between first impression and personality. The results suggest that, during impression reversal, IE requires more valuation updates whereas EI is better learned with greater emotional response.

I17

ALONE OR TOGETHER. INTERACTIVE OR INDIVIDUAL EMOTIONS IN CROWDS: AN FMRI STUDY. Elisabeth Huis in 't Veld[1], Beatrice de Gelder[1,2,3]; [1]Cognitive and Affective Neuroscience Laboratory, Tilburg University, Tilburg, the Netherlands, [2]Brain and Emotion Laboratory Leuven, Katholieke Universiteit Leuven, Leuven, Belgium, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital and Harvard Medical School — Studies on the perception of crowds are gaining a lot of interest, also in the ICT community. However, most studies have used static stimuli portraying many individuals put together in a picture, even though the interaction and synchronisation of movement between the individuals is of importance. To study the neurological underpinnings of natural and emotional crowd perception, participants viewed video stimuli of a group of actors that were displaying a neutral, happy or fearful emotion. However, in one condition, the crowd was collectively sharing the emotion, and in the other each group member experienced the emotion without interacting with the others. The results show that early visual processing areas and areas related to biological motion already respond differently to collectively shared emotion and that this is stronger for some emotions than others. These results not only provide insights for neuropsychological social interaction research, but also for game and security software development.

I18

NEUROFUNCTIONAL BASIS OF GROUP INFLUENCES ON ACTION PREPARATION Ruud Hortensius[1], Beatrice de Gelder[1,2,3]; [1]Cognitive and Affective Neuroscience Laboratory, Tilburg University, [2]Brain and Emotion Laboratory Leuven, Katholieke Universiteit Leuven, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital and Harvard Medical School — We spontaneously react to the actions of other people. Reflex like, automatic helping behavior has been observed in humans and in other primates indicating a neurobiological basis for assisting conspecifics in difficulty. However, it is well known that the likelihood of helping a person in distress decreases with the increasing number of bystanders (the "bystander effect"). So far only top down mechanisms and higher cognitive explanations were provided for this effect. The goal of this study is to measure the influence of a social context consisting of a group of bystanders on these processes. We take a bottom-up perspective and argue that a reduction in action preparation and emotional processing underlie the diminished helping behavior as a function of group size. We measure both implicit behavioral and neurofunctional effects of social context. In a slow-event related fMRI design participants viewed dynamic stimuli of a woman in need while she was alone or with 1, 2 or 4 bystanders while they perform an unrelated color detection task. Preliminary fMRI results reveal that two separate processes reflect the influence of a group: i) reduction in activity with more bystanders in an action preparation network, ii) increase in activity with more bystander in brain areas associated with inferring mental states of others. Our results are consistent with the hypothesis that diminished helping behavior is related to an automatic influence of group size on these processes. Currently, we are testing this to further extend.

I19

SOMETHING ALWAYS STICKS – EMOTIONAL INFORMATION MODULATES THE OLD-NEW EFFECT FOR NEUTRAL FACES Janine Strehlow[1], Johanna Kissler[1,2]; [1]University of Konstanz, Konstanz, Germany, [2]University of Bielefeld, Bielefeld, Germany — Many studies show that processing of emotional faces elicits larger brain activity than processing of neutral faces. In the EEG effects are seen at early (N1, Early Posterior Negativity ~ EPN) and late (late positive potential ~ LPP) processing stages. Here, we investigate the effect of linguistic emotional information on subsequent perception and neural processing of originally neutral faces. Event-related potentials were collected from 24 healthy students (12 male, 12 female). During the first run, participants viewed briefly presented neutral male faces. In the second run, each face was preceded by a descriptive phrase

including either information about the person's occupation or supposed criminal activities. Finally, in a third run the original faces were re-presented randomly mixed with new faces and participants were instructed to perform an old-new recognition test on the faces. Behaviorally, the associated information did not affect recognition memory. Participants were unable to discriminate the faces reliably. However, on a neural level the associated information modulated the ERP old-new effect around 500 ms post-stimulus presentation. Old faces that had been associated with negative information elicited larger centro-parietal positivity than old faces that had been associated with neutral information. Despite this increased LPP, no context-related modulation was found for earlier ERP components such as the N1 or the EPN. Results indicate that linguistic emotional information modulates neural processing of faces at distinct processing stages in the absence of overt discrimination and demonstrate the power of verbal emotional information in implicitly altering neural mechanisms of person perception.

I20

ELECTROPHYSIOLOGICAL CORRELATES OF THE DETECTION OF SINCERE COMPLIMENTS AND WHITE LIES Simon Rigoulot[1], Karyn Fish[1], Marc D. Pell[1]; [1]School of Communication Sciences and Disorders, Faculty of Medicine, McGill University — During social communication, linguistic and extra-linguistic cues combine to indicate the real meaning of what is said (i.e., the true intentions of the speaker). Previously, we demonstrated that listeners rely significantly on vocal cues, such as speech rate and pitch differences, to interpret the sincere or insincere nature of a compliment embedded in a verbal exchange. Here, we investigated by means of Event-Related Potentials how the brain detects the intended meaning of sincere and insincere compliments (white lies). We recorded the electroencephalogram of 33 participants while they heard 52 Question-Response pairs (e.g., Question: "So, what did you think of my presentation ?" / Answer: "I found it really interesting."). Participants judged whether responses were spoken in a way to be either sincere or insincere (26 items each). Behaviorally, we observed that the overall accuracy of participants was high (81% correct responses) but that the detection of sincere compliments was easier than the detection of white lies ("truth bias"). Electrophysiological analyses revealed three components--respectively peaking at 200, 260 and 380 ms after the onset of the responses and located in right posterior, fronto-central and left anterior areas--that were differently activated according to the sincere or insincere intention of the speakers. These data begin to unravel some of the brain mechanisms involved in the detection of the underlying intentions of speakers during conversation, crucial for social perception and cognition and in the production of socially adapted behaviors.

I21

IMPLICIT MEMORY FOR PUPIL SIZE: EFFECTS ON PERSON JUDGMENT. Ralph Pawling[1], Steven Tipper[1]; [1]Bangor University — Since the Italian Renaissance it has been known that pupil size is automatically encoded when viewing a face, motivating the use of poisonous extracts from the belladonna plant to dilate pupils. Subsequent experimental studies have confirmed that faces with dilated pupils influence person perception. However, all previous studies demonstrated online effects, during direct observation of faces with pupils of different sizes. The current study demonstrates for the first time that pupil size, interacting with the trustworthiness of a person, is encoded into memory and influences judgments of an individual at a later time. In two experiments, participants were presented with faces whose pupils consistently dilated or constricted, without the participant's awareness of this manipulation. In a second task the participants made judgements regarding the friendliness and level of interest of the faces, but made these judgements in response to versions of the faces with average sized pupils. In Experiment 1 female faces whose pupils had dilated elicited significantly higher ratings than those whose pupils had constricted. This effect was reversed for ratings of male faces. In Experiment 2, participants viewed only male faces, pre-rated as high or low trustworthiness. Like female faces, high-trust males whose pupils dilated received significantly higher ratings than those whose pupils constricted. However, the opposite effect was found for the low-trust male faces. These results suggest the effects of pupil size go beyond the current moment of interpersonal interaction, and modulated by apparent trustworthiness, influence longer-term representations, enabling predictions of future interactions.

I22

AFFECTIVE SOUNDS ENHANCE ELECTRO-CORTICAL FACE PROCESSING – A STEADY-STATE EVOKED POTENTIALS STUDY Matthias J Wieser[1], Antje B M Gerdes[2], Christian Karl[1], Paul Pauli[1]; [1]University of Würzburg, [2]University of Mannheim — In everyday life, faces are embedded in social and affective contexts like affective sounds. Early stages of face processing have been shown to be modified by visual context information and congruent prosody facilitates emotional face recognition. However, little is known about how affective sounds influence face processing. Thus, facial expressions (neutral, fearful, happy, surprised) were presented together with affective sounds. Faces were flickered at 15 Hz to evoke steady-state evoked potentials (ssVEPs). Results showed significant modulation of the ssVEP amplitudes by affective sounds: overall, ssVEP amplitude in response to faces was elevated when paired with affective compared to neutral sounds. Interestingly, processing of ambiguous facial expressions (surprised and neutral) was differentially influenced early (-1500 ms): Processing of surprised facial expressions was enhanced both for pleasant and unpleasant sounds, whereas processing of neutral faces was elevated during unpleasant sounds, only. A follow-up experiment confirmed that affective sounds boosts face processing in general. The results show that processing of facial expressions is influenced by auditory context information. Interestingly, effects are already present in the first 1500 ms for ambiguous facial expressions suggesting quick information extraction from auditory channels and audiovisual integration when visual information does not suffice. The general enhancement of visual face processing by affective sounds suggests that emotionally relevant information from one modality boosts processing of another sensory modality. Most likely, this is accomplished in convergence zones such as in the amygdala and the middle temporal gyrus, but possibly also due to direct crosstalk between auditory and visual associative cortices.

I23

EVENT-RELATED POTENTIALS TO STATIC AND DYNAMIC EXPRESSIVE FACES Karissa Reiter[1], Abigail Mayfield[1], Reiko Graham[1]; [1]Health Psychophysiology Lab, Department of Psychology, Texas State University — Nonverbal expression, including facial expressions, typically unfolds dynamically. However, the majority of event-related potential (ERP) studies examining the neural correlates of facial expression processing have employed static displays. The objective of this study was to compare the timecourses of ERPs to static and dynamic expressive faces. A secondary objective was to determine whether individual differences in empathy were systematically related to ERP components. Twenty-three participants (10 male, 13 female; mean = 22.6 years) viewed either static or dynamic displays of fearful and angry faces, and completed the Empathizing (EQ) and Systematizing Quotients (SQ), and the Davis Interpersonal Reactivity Scale (IRI). Examination of early ERPs over lateral occipital areas revealed that amplitudes of the P100 and N170 were larger for static displays. The P100 was also sensitive to emotion, being larger for angry faces over the right hemisphere. Movement effects were evident in later ERP components, being larger for the P250/N250 over lateral occipital/central areas and were also manifested in increased amplitudes in a widespread late positive component. P100 amplitudes to static faces were significantly correlated with scores on the EQ and P250/N250 amplitudes to moving faces were significantly correlated with the Empathic Concern subscale of the IRI (i.e., higher scores on these scales were associated with higher amplitudes). Results suggest that the addition of movement alters the timecourse of ERPs to facial expressions, possibly by reducing processing loads at earlier stages of encoding and enhancing later processing. Furthermore, individual differences in empathy may modulate these responses.

I25

COMPETENCE EVALUATIONS IN FIRST ENCOUNTERS: AN FMRI INVESTIGATION OF THE NEURAL CORRELATES OF NON-VERBAL COMMUNICATION IN SOCIAL INTERACTION Sanda Dolcos[1], Keen Sung[2], Florin Dolcos[1]; [1]University of Illinois at Urbana-Champaign, [2]University of Massachusetts Amherst — Effective social interactions require the ability to evaluate other people's actions and intentions, sometimes only on the basis of subtle body language cues. Such evaluative judgments may lead to powerful first impressions, which may further influence social and financial decisions. However, little is known about the impact of affective body language on evaluative responses in social settings, and the associated neural correlates. In the present study, fMRI data were recorded while 18 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. Approach trials were associated with greater ratings (competence, trust, interest) than the Avoid trials. Brain activity in regions of the social cognition network, including the superior temporal sulcus (STS) and the amygdala, was sensitive to processing cues for both the Approach and Avoid trials, compared to a no-social interaction condition, while also showing greater sensitivity to the Approach condition. Furthermore, STS and amygdala activity had distinct roles in evaluating competence. Specifically, increased STS activity was associated with a negative evaluation of competence for the Avoid behavior, possibly reflecting the necessity to further assess the intentions of avoiding strangers. On the other hand, increased amygdala activity was associated with a positive evaluation of competence for the Approach behavior, possibly reflecting positive emotions to the Approach behavior. These findings have relevance for understanding the neural correlates of non-verbal communication in social interactions, and its specific effects on competence evaluations.

I26

MDMA (3, 4-METHYLENEDIOXYMETHAMPHETAMINE, ECSTASY) INCREASES RATINGS OF TRUSTWORTHINESS OF FACES BY A SEROTONERGIC MECHANISM Matthew Baggott[1], Kathleen Garrison[2], Jeremy Coyle[2], Keith Flower[2], Gant Galloway[2], Sara Verosky[3], Nikolaas Oosterhof[4], Alexander Todorof[3], John Mendelson[2]; [1]University of Chicago, [2]California Pacific Medical Center Research Institute, [3]Princeton University, [4]Bangor University — MDMA is a widely used illicit drug and experimental adjunct to psychotherapy that can induce feelings of sociability. It is unknown whether MDMA also alters perception of others' traits. Here, we show that MDMA increases feelings of closeness to others and perceptions of trustworthiness by a serotonergic mechanism. In a double-blind, placebo-controlled, within-subjects MDMA-citalopram interactions study, 13 healthy MDMA-experienced participants rated the trustworthiness and dominance of computer-generated faces and reported feelings of sociability (visual analog item "closeness to others"). MDMA alone increased peak VAS "closeness to others" and ratings of the trustworthiness (but not dominance) of faces. Citalopram pretreatment significantly attenuated these effects, suggesting that they depend on MDMA interactions with the serotonin transporter.

I27

AUTOMATIC INFERENCE OF ANIMACY: DOTS IN CIRCLES ACTIVATE THE NEURAL SUBSTRATE FOR ANIMACY DETECTION Kelly Anne Barnes[1], Kevin M. Anderson[1], Alex Martin[1]; [1]National Institute of Mental Health — It has been well established that simple visual stimuli whose motion is evocative of animate agents or which appear in contexts associated with animate agents activate brain regions important for social cognition. Minimalist stimuli were presented during functional MRI to test whether such brain regions (e.g., posterior superior temporal sulcus [pSTS] and ventromedial prefrontal cortex [vmPFC]) would be recruited during motion direction discrimination (left/right) when patterns of motion and context were carefully controlled. Adults determined motion direction for two stimulus types: plain white dots and white dots with two red dots (previously shown to be perceived as animate, Gao et al., 2010). Critically, task demands and patterns of motion were matched across stimuli, and subjects were explicitly told that there was no relationship between the position of the red dots and the direction of motion for the experimental stimulus. A distributed set of brain regions was active during the task. Activation in hMT+ was consistent with a role in general sensory processing, showing robust activation for both stimulus conditions. Activation in dorsal anterior cingulate and bilateral anterior insula was consistent with a role in general decision making, with responses modulated by subjects' decision times for both stimuli. In contrast, activation in pSTS and vmPFC was greater for stimuli with red dots than the plain dots, but was not modulated by subjects' decision times, revealing stimulus-sensitive sensory processing. These results show that minimalist stimuli presented in non-social contexts automatically recruit brain regions important for animacy inference.

I28

"WHO'S COOLER?": NEURAL MECHANISMS UNDERLYING SOCIAL COMPARISONS INVOLVING THE SELF AND SIMILAR OR DISIMILAR ACQUAINTANCES. Will Moore[1], Junaid Merchant[1], Lauren Kahn[1], Jennifer Pfeifer[1]; [1]University of Oregon — The ability to carry out social comparisons and its underlying neural mechanisms is an emerging area of research interest, but most paradigms employed to date have asked participants to make decisions about abstractly familiar, but not personally acquainted, others. In this fMRI study, we asked participants to engage in social comparisons between themselves and several acquaintances, selected on the basis of high or low self-similarity. Distinct patterns of activity in regions routinely implicated in social cognition (e.g., inferior frontal gyrus (iFG), posterior superior temporal sulcus (sTS), medial and parietal cortical midline structures) were observed based on the absolute and relative degrees of self-similarity of individuals compared. Participants (n = 19) underwent BOLD fMRI while engaging in social comparisons between themselves and several acquaintances, selected on the basis of high or low self-similarity. The task was to decide which of two pseudo-randomly chosen targets better exemplified a trait adjective. Traits were evenly distributed across trials consisting of comparisons between the subject and a similar (YS) or dissimilar peer (YD) or a similar peer and another similar (SS) or dissimilar peer(SD). Trials in which the participant was personally involved compared to those involving familiar others were associated with greater activity in ventral medial prefrontal cortex (vmPFC) and bilateral pSTS, while the reverse contrast revealed increased activity in the mPPC, bilateral iFG, and medial orbitofrontal cortex. Further distinctions along anterior-posterior and medial-lateral gradients were additionally observed, varying as a product of the absolute or relative degree of self-similarity of each individual involved.

EXECUTIVE PROCESSES: Monitoring & inhibitory control

I29

AN ERP INVESTIGATION OF JOINT ACTION IN A SHARED VERSUS NON-SHARED STROOP TASKS: UTTERANCE MATTERS Sukru Baris Demiral[1], Chiara Gambi[2], Martin Pickering[3]; [1]Washington University in St. Louis, [2]University of Edinburgh, [3]University of Edinburgh — Representing others' actions is a fundamental property of human social cognition (Sebanz et al., 2003). In two ERP experiments (N=25), we explored whether participants would represent each others' tasks in a joint performance of a two-color Stroop task. In Exp.1, ERP participant responded to one color while the other participant gave feedback. In Exp.2, each participant responded to different colors while they gave feedback to each other. The experimental conditions were 2x2x3, CONGruency (Congruent vs. Not-Congruent), Task (Go vs. No-Go), TOPography (Frontal, Central, Posterior). The stimulus word was shown for 500ms, followed by a blank screen for 700ms, after which a cross was shown. Participants waited for the cross to utter their responses. Our hypothesis was that when partici-

pants shared the task (Exp.2), the inhibitory N2 Stroop effect (Liotti et al., 2000) would be equally pronounced for the No-Go conditions due to the joint representations. In Exp.1, in 230-290ms, there was an interaction between Task and Congruency ($F(1,23)=6.31$, $p<.05$), where Incongruent-Go conditions were significantly more negative than the Congruent-Go conditions ($F(1,24)=8.03$, $p<.01$). In Exp.2, Congruency effect was significant only in the parietal electrodes ($F(1,23)=4.43$, $p<.05$). Strikingly, in the earlier P2 window (170-230ms) both the frontal ($p<.05$) and the parietal electrodes ($p<.05$) showed the main effect of Congruency. Our results indicate that when people shared the Stroop task, other participant's Incongruent-Go response had an effect on the N2 component of the ERP participant's No-Go response. P2 was found to be another index for the effect of joint action related congruency effect.

I30

INVESTIGATING EXECUTIVE CONTROL NETWORKS WITH A STIMULUS ONSET ASYNCHRONY MANIPULATION IN THE STROOP TASK

Emily Coderre[1], Walter JB van Heuven[1]; [1]University of Nottingham — Stimulus onset asynchrony (SOA) manipulation in a Stroop task has previously demonstrated that different conflict-related processes are employed in each SOA depending on the magnitude and the nature of the conflict (Coderre et al. 2011). This study uses the Stroop SOA paradigm and functional magnetic resonance imaging (fMRI) to investigate how recruitment of the executive control (EC) network in the brain is modulated by pre-exposure of the irrelevant (word) stimuli. Fourteen subjects performed a Stroop task with three SOAs (-400, -200, 0 ms) while fMRI data was collected in a 3T scanner. A disparity was found between the imaging and behavioral data: the 0 ms SOA elicited stronger and more extensive brain activation, whereas the -200 ms SOA generated greater behavioral interference. This suggests that reduced Stroop interference is driven by a more active recruitment of the executive control network. Functional connectivity analyses indicated that a similar EC network was activated in each SOA, but the specific areas recruited within that network differed between SOAs, indicating that the EC is differentially recruited based on the nature and magnitude of conflict. Structural analyses indicated that behavioral Stroop interference effects were correlated with increased grey matter (GM) volume in the left angular gyrus, while behavioral Stroop facilitation effects were correlated with GM volume in the left inferior frontal gyrus, suggesting different underlying mechanisms contributing to Stroop interference and facilitation effects. These results from SOA manipulation highlight the complex and flexible nature of the EC system and its interaction with the language network.

I31

SPEED PRESSURE AND THE EXPRESSION AND SUPPRESSION OF ACTION IMPULSES IN PARKINSON'S DISEASE

Scott Wylie[1], Wery van den Wildenberg[2], K. Richard Ridderinkhof[2]; [1]Vanderbilt University Medical Center, [2]University of Amsterdam — Strategic adjustments in response speed as well as inhibitory action control have been linked to basal ganglia function. These processes often interact. Pressing for performance speed increases the interference from stimulus-driven action impulses, thus increasing demands on inhibitory control. This speed effect on impulse control is especially apparent in conflict tasks (e.g., Simon task), where irrelevant features of stimuli activate action impulses that correspond or conflict with goal-directed action selection. Parkinson's disease (PD) patients are less proficient at suppressing the interference produced by action impulses, so we investigated the hypothesis that pressing for performance speed would further exacerbate this deficit. PD patients (n=21) and healthy controls (HC) (n=21) performed a Simon task under task instructions that emphasized speed or accuracy of responding. Guided by the conceptual framework of the dual process activation-suppression model, we performed distributional analyses to dissociate susceptibility to impulsive action and the proficiency of suppressing action impulses as an act of cognitive control. Both groups adjusted performance speed according to instructions. On conflict trials, pressing for speed increased fast, impulsive errors for both groups similarly. For HC, focusing on accuracy led to earlier suppression of incorrect action impulses. Overall, PD patients were less proficient than HC at suppressing the interference produced by impulsive actions, and speed pressure exacerbated this difference. These results suggest that action control deficits in PD are modifiable by intentional adjustments in performance strategy and add to recent evidence suggesting key involvement of the basal ganglia in action control.

I32

REWARD PROCESSING AND COGNITIVE CONTROL: EVIDENCE FOR REDUCED FUNCTIONAL CONNECTIVITY IN SUBSTANCE ABUSE

Julian C. Motzkin[1], Joseph P. Newman[1], Kent A. Kiehl[2,3], Michael Koenigs[1]; [1]University of Wisconsin - Madison, [2]MIND Research Network, [3]University of New Mexico — Compulsive drug seeking behavior is thought to reflect an increase in the salience and reward value of drug-related cues with an associated reduction in inhibitory behavioral control. Neurocognitive models of substance use disorders (SUDs) typically propose disrupted interactions between the ventral striatum (VS, a brain region implicated in the representation of reward) and the dorsal anterior cingulate cortex (dACC, a brain region implicated in inhibitory behavioral control). To test the hypothesis that interactions between VS and dACC may be disrupted in drug abusers, we examined resting state functional connectivity to identify regions in which individuals with SUD have altered VS connectivity relative to non-abusers. Resting state functional MRI data were acquired from 40 incarcerated male prison inmates (SUD group: n =22; Non-SUD group: n = 18). SUD diagnosis was based on the Structured Clinical Interview for DSM-IV Disorders (SCID). The SUD group had significantly lower functional connectivity between the bilateral VS seed region and a cluster in the dACC/BA32 ($p < 0.05$, corrected). When psychopathy was included as a covariate (assessed using the Psychopathy Checklist – Revised), additional clusters in the right inferior frontal gyrus and left dorsolateral prefrontal cortex were also observed ($p < 0.05$ corrected), suggesting interactions between SUD and psychopathy in these regions. These results support the hypothesis that drug abuse is associated with impaired interactions between the VS and dACC, two central hubs in a network implicated in addiction and drug abuse.

I34

FOCUSED ULTRASOUND LESIONING OF THE VIM THALAMUS MODULATES INHIBITORY CONTROL IN ESSENTIAL TREMOR PATIENTS

Scott A. Sperling[1], Wery P.M. van den Wildenberg[2], Scott A. Wylie[3], William J. Elias[1]; [1]University of Virginia, [2]University of Amsterdam, [3]Vanderbilt University — Surgical lesioning and deep brain stimulation of the ventral intermediate (VIM) nucleus of the thalamus improves action tremor in patients diagnosed with Essential Tremor (ET). Magnetic resonance-guided focused ultrasound has been introduced recently as a non-invasive procedure for lesioning VIM thalamus in ET patients. Expanding on the role of VIM "motor" thalamus in involuntary motor processes, we investigated the hypothesis that focused ultrasound in the VIM of the thalamus would also improve voluntary motor control. Nine patients with ET performed the Stop-Signal task before and three months after focused ultrasound lesioning of the VIM thalamus contralateral to their dominant hand. The Stop-Signal task measures the speed of voluntary manual response time to go stimuli as well as the speed of inhibiting voluntary actions upon the occurrence of a stop stimulus. Focused ultrasound of the VIM thalamus did not alter the speed of action generation in the treated hand ($p>.10$), but improved the speed of inhibiting an action initiated for the treated hand by approximately 40 ms ($p<.05$). These results raise intriguing ideas about the role of VIM thalamus, which is primarily innervated by cerebellar afferents, in voluntary action control. Furthermore, these findings provide initial support that surgical lesioning of the VIM improves both involuntary and voluntary motor processes in patients with ET.

I35

DISRUPTED OSCILLATORY NEURONAL NETWORKS IN SCHIZOPHRENIA DURING CONTEXT PROCESSING Seung Suk Kang[1,2], Jessica Jones[2], Angus MacDonald[1], Scott Sponheim[2,1]; [1]University of Minnesota, [2]Minneapolis VA Medical Center — The present study investigated functional network in schizophrenia patients during context processing using novel time-frequency-phase-synchrony (TFPS) measures of inter-regional functional connectivity between distant oscillatory neural signals. Thirty normal controls and 30 schizophrenia patients participated. During stimulus response reversal task (SRRT), subjects saw sequences of color-cue and arrow-probe pairs and responded according to conditions. For green-cues, subjects were instructed to press a right/left button to the direction of the following arrow, while for red-cues, they were instructed to press a button to the opposite direction of the following arrow. EEG data was recorded in 128-electrodes, preprocessed with independent component analysis to remove noises, and segmented to -200~2000 ms relative to cue onsets. TFPS was computed for 65 electrode-pairs and averaged across three time periods; activation (0~600 ms), delay-1 (601~1200 ms), and delay-2 (1201~2000 ms). Principal component analysis (PCA) was conducted for the time-averaged frequency phase-synchrony values, and four frequency principal components (PCs) were obtained; alpha: 8~13 Hz, beta: 17~30 Hz, low-gamma: 31~42 Hz, and high-gamma: 43~55 Hz. PCA was also conducted for the frequency PC loadings across the 65 electrode-pairs, and 5 or 6 spatial PCs were obtained in each frequency PCs. Patients had low accuracy (t58=3.00, p=.004) and slow reaction time (t58=2.82, p=.007) for red-cue trials than controls. They also had deficient phase-synchrony in spatial PCs of fronto-parieto-occipital network in alpha (t58=3.06, p=.003) and beta frequency (t58=2.72, p=.009) during the delay period, suggesting that disrupted alpha/beta oscillatory neural communications in fronto-parieto-occipital network might underlie context processing deficits in schizophrenia.

I36

METHYLPHENIDATE INCREASES SIGNAL TO NOISE IN THE RESTING BRAIN Clare Kelly[1], Robert Hester[2], L. Sanjay Nandam[3], F. Xavier Castellanos[1,4], Michael Milham[4,5], Mark Bellgrove[3]; [1]NYU Child Study Center, [2]University of Melbourne, [3]University of Queensland, [4]The Nathan Kline Institute for Psychiatric Research, [5]Child Mind Institute — Catecholaminergic agents methylphenidate (MPH) and atomoxetine (ATM) are commonly used in the treatment of Attention-Deficit/Hyperactivity Disorder (ADHD). Although their mechanisms of action are well understood at the molecular level, the neuronal bases of their beneficial effects on cognition and behavior are less well understood. Animal work demonstrating their effects on neuronal firing in prefrontal cortex (PFC) has led to the hypothesis that MPH and ATM increase signal-to-noise within neuronal circuits. Resting state fMRI data lend themselves to the examination of such effects in humans, by permitting the interrogation of two aspects of intrinsic brain activity: the strength of the intrinsic activity itself (brain "noise"), and local and global synchrony ("signal") among brain regions, known as network centrality. We examined the effects of MPH (30mg), ATM (60mg), citalopram (CIT; 30mg) and placebo (PLAC; dextrose) on voxel-wise measures of intrinsic activity (ALFF) and network centrality (Degree and Eigenvector Centrality – DC and EC) in 27 males (18–35yrs) using a randomized, placebo-controlled design. Effects were strongest for MPH: decreases in ALFF were localized to primary sensory and motor areas, while increases were observed in prefrontal and parietal cortex, and the striatum. Similarly, decreases in local synchrony (DC) were observed throughout sensorimotor cortex, while MPH-related increases in global synchrony (EC) occurred in PFC and striatum. The latter were related to MPH-related behavioral improvements on a stop signal response time task. These findings suggest that monoamine drugs alter signal-to-noise in large-scale brain networks and provide testable hypotheses regarding catecholaminergic effects in disorders such as ADHD.

I37

THE NEURAL CORRELATES OF IMPAIRED VISUAL INTERFERENCE CONTROL IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER Shawn E. Christ[1], Amanda J. Moffitt[1], Lindsay E. Kester[1], Kimberly Bodner[1], Judith H. Miles[1]; [1]University of Missouri — Given the countless sources of visual information that we encounter on a moment-to-moment basis, the ability to filter and resist interference from visual distractors (RIVD) is critical for efficient functioning in everyday life. Recent studies (e.g., Christ et al., 2007, in press) have documented impaired RIVD in individuals with autism spectrum disorder (ASD). In the present study, we utilized functional magnetic resonance imaging (fMRI) to examine the neurocognitive disruption(s) that contribute to RIVD impairment in ASD. A sample of 16 individuals with ASD (mean age = 15.5 years) and 11 neurologically intact individuals without ASD (mean age = 15.9 years) were imaged while performing a typical flanker visual filtering task. In this task, participants had to respond to a centrally-presented target stimulus which was flanked closely to the left and right by distracting stimuli that could be either compatible or incompatible with the target. Group-differences in RIVD-related activity were observed in several brain regions including left dorsolateral prefrontal cortex (DLPFC). Although speculative, these results are consistent with the hypothesis that disruptions in DLPFC -mediated processes associated with the top-down monitoring and regulation of interference control may contribute to RIVD impairment in ASD.

I38

CULTURAL VARIATION IN NEURAL BASIS OF RESPONSE INHIBITION Narun Pornpattananangkul[1], Ahmad Hariri[2], Tokiko Harada[4], Yoko Mano[1], Hidetsugu Komeda[3], Todd Parrish[1], Norihiro Sadato[3], Tetsuya Iidaka[4], Joan Chiao[1]; [1]Northwestern University, [2]Duke University, [3]National Institute for Physiological Sciences, Okazaki, Japan, [4]Nagoya University, Nagoya, Japan — In order to function well in society, people are expected to inhibit their responses although the extent which this occurs may vary from culture to culture. Numerous aspects of society, from childrearing to hierarchical preference, illustrate how cultures may vary in their preference for response inhibition. However, very little is known about how neural mechanisms underlying inhibitory-related activity are shaped by culture. Here we conducted cross-cultural functional magnetic resonance imaging (fMRI) in two cultures that differ in the degree to which response inhibition is emphasized: Japan (high emphasis) and the US (low emphasis). Results show that Caucasian-American and Japanese-Americans show increased response within prefrontal regions, including precentral gyrus, cingulate gyrus, medial frontal gyrus, compared to native Japanese. By contrast, native Japanese show increased response within basal ganglia, including caudate, brain regions previously shown to correlate with impulsivity. Taken together, these results provide novel evidence of cultural variation in the neural basis of response inhibition.

I39

NEURAL MARKERS OF CIGARETTE CRAVING AND REGULATION Junaid Merchant[1], Will Moore[1], Elliot Berkman[1]; [1]University of Oregon — Regulation of craving is a critical process for successful smoking cessation. Prior work has implicated the interplay between lateral prefrontal cortices and the striatum as potential neural correlates of this process in active smokers. To examine this relationship further, the current study integrated neuroimaging methodologies (fMRI), physiological indices of smoking regularity (percent exhaled CO2) , and a cognitive regulation task to examine the neural correlates of craving regulation, and its role in successful quitting for smokers enrolled in a cessation program. 29 community participants (14 female) enrolled in a cigarette cessation program completed a fMRI scan, along with baseline psychometric (FTND, Positive/Negative Urges scale) and physiological measures of smoking prior to starting the program. During the fMRI scan, participants were presented with cigarette cues and were instructed to either focus on the immediate sensations of a cigarette (craving) or to think of the long term consequences (regulation). 26 participants returned to provide post mea-

sures 3 weeks into the intervention. Our data shows that increases in physiological indices of successful smoking cessation were correlated with activity in lateral prefrontal regions (inferior frontal gyrus/dorsolateral prefrontal cortex) while subjects considered the long-term consequences of smoking. Extending these findings beyond the laboratory, we also found that lateral prefrontal activity was correlated with later self-report measures of cigarette use. The current study not only replicates findings linking prefrontal cortical activity to craving regulation, but also uses such activity in the brain to accurately predict subsequent quitting behavior.

EXECUTIVE PROCESSES: Other

I40

MODELLING THE EFFECT OF PERCEIVED OWNERSHIP ON REWARD EVALUATION Cameron D. Hassall[1], David J. Turk[2], Olav E. Krigolson[1]; [1]Dalhousie University, [2]University of Aberdeen — Recent work by Krigolson et al. (submitted) found that perceived ownership of won or lost objects biased the amplitude of the feedback error-related negativity (fERN), a component of the event-related brain potential (ERP) sensitive to rewards and punishments. In that study, participants completed a simple gambling task in which an item was won or lost on every trial. Each trial included an ownership cue—the item was either won or lost by the participant or someone else. Krigolson and colleagues results demonstrated a reduced fERN magnitude following an other-ownership cue. Here, we adapted a previous reinforcement-learning model for a decision-making task by Holroyd and Coles (2008) that predicted both human performance and fERN amplitudes to simulate the ownership task. In our model, fERN amplitude was predicted by the error term from a temporal-difference (TD) component. Further, our model includes an ownership unit that biased the TD unit, and thus accounted for the differences in fERN amplitude between the self- and other-ownership conditions.

I41

GOAL-ORIENTED OBJECT KNOWLEDGE RETRIEVAL UNDER UNCERTAINTY Evangelia G. Chrysikou[1], Sharon L. Thompson-Schill[2]; [1]University of Kansas, [2]University of Pennsylvania — Recent research in neuroscience has shown that some cognitive tasks benefit from a tradeoff between brain regions involved in rule-based processing and regions involved in object processing. For instance, past work from our lab has provided evidence for such a tradeoff between prefrontal cortex (PFC) and visual cortex in a creative object use generation task, during which participants were asked to generate an uncommon use for a series of common objects. In this experiment we used functional magnetic resonance imaging to explore this tradeoff in a creative goal implementation task, during which participants were asked to generate an uncommon object they would use to satisfy a series of common goals. Thirty participants were shown common goals (e.g., 'to roll out dough') and they either generated verbally the most common object that could be used to satisfy the goal (e.g., 'rolling pin') or an uncommon object that could be used instead, if the typical objects were unavailable (e.g., 'baseball bat'). In both conditions participants also completed a baseline task. The results of the random effects and region of interest analyses showed that left PFC regions provide support for such goal-oriented behavior. Critically, analyses revealed a significant interaction in left inferior parietal cortex which may reflect decision making about which object will best satisfy each goal under conditions of uncertainty during the uncommon object task. The results are discussed in the context of measures of individual differences, including cognitive control, mood, and personality assessments.

I42

FRONTAL OSCILLATORY DYNAMICS GUIDE FEEDBACK LEARNING VIA INTER-SITE PHASE SYNCHRONIZATION Irene van de Vijver[1], K. Richard Ridderinkhof[1], Michael X Cohen[1,2]; [1]University of Amsterdam, [2]University of Arizona — To accomplish action improvement and learning, performance feedback must be used to create new and adjust existing stimulus-response(-outcome) associations. Medial frontal brain areas seem to play an important role in feedback processing: an increase in oscillatory activity in the theta frequency band (4-8 Hz) has been implicated in the processing of errors and negative performance feedback, whereas positive performance feedback can induce an increase in beta-band oscillatory activity (15-30 Hz). In this project we investigated how the brain uses these feedback-related local theta- and beta-band signals to adjust stimulus-response associations and performance on a next encounter (trial). Because the frontal cortex may use electrophysiological oscillatory synchronization to coordinate other systems during learning, we used EEG and MEG to examine changes in oscillatory dynamics both within and between sites in a network of frontal, stimulus-processing and response-processing brain areas during feedback-based learning. Data from multiple experiments will be presented, in which we demonstrate the relation between oscillatory brain dynamics and subsequent performance adjustment, as well as changes in oscillatory feedback processing with aging.

I43

DISENTANGLING THE NEURAL CORRELATES OF VALENCE AND EXPECTANCY IN FEEDBACK PROCESSING Bertram Opitz[1], Nicola K. Ferdinand[1]; [1]Saarland University — Despite the general agreement that the ventral striatum and the mediofrontal cortex, especially the ACC play an important role in feedback processing, there is much less consensus about the exact nature of their involvement. Previous studies have identified at least two crucial factors, namely feedback valence and unexpectedness that might determine the specific involvement of these brain structures in feedback processing. As these two factors were often confounded in previous research we employed a novel experimental task that separated the valence and the unexpectedness of performance feedback. In a variant of the time estimation task participants (N=20) were asked to indicate when a 2.5sec empty interval had elapsed. Performance feedback was provided via an adaptive mechanism tied to each participant's performance that ensured the unexpected occurrence of positive and negative feedback (only 20% of cases, respectively), while neutral feedback occurred in 60% of cases and therefore was expected. In the present functional magnetic resonance imaging (fMRI) study participants perceived a total 300 feedback stimuli. The behavioral results show that the adaptive mechanism succeeded in generating the intended frequency distribution for the three feedback types. Participants received positive feedback (19.98%) when responding on average within a ±105ms time window and negative feedback (19.14%) when responding outside a ±552ms time window around the 2.5 sec. Preliminary fMRI results indicate that brain activity in both regions varied as a function of valence and expectancy. Further analysis will use a parametric approach to examine the pattern of activity in both regions in more detail.

I44

INFORMATION PROCESSING SPEED IS RELATED TO ANTERIOR CINGULATE FUNCTIONAL CONNECTIVITY IN MULTIPLE SCLEROSIS Katherine Koenig[1], Erik Beall[1], Jian Lin[1], Blessy Matthew[1], Lael Stone[1], Robert Bermel[1], Stephen Rao[1], Bruce Trapp[1], Micheal Phillips[1], Mark Lowe[1]; [1]The Cleveland Clinic — Cognitive impairment is common among those diagnosed with multiple sclerosis (MS), with estimates of affected individuals ranging from 40-70%. Several structural and functional MRI measures show correlation with cognitive impairment on a variety of tasks, presumably as a consequence of compromised white matter integrity. The current study uses resting state low frequency temporal fluctuations as measured using blood oxygenation level-dependent (BOLD) weighted imaging to measure functional connectivity (fcMRI) of the right anterior cingulate (ACC) in MS and controls. FcMRI to the ACC has

previously been shown to correlate with measures of cognitive performance in MS. The goal of the current study is to establish how resting state fcMRI is related to cognitive performance in MS and controls. 47 MS patients and 24 healthy controls underwent anatomical and resting state connectivity scans. 10 controls and 10 MS subject performed a verbal memory retrieval task. fMRI activation from this task was used to seed the right ACC. Functional connectivity maps were created for each individual and transfered to Talairach space. Performance on the SDMT, a measure of information processing speed commonly used in MS, was correlated on a voxel-wise basis with connectivity maps. In patients, performance on the SDMT correlated with right ACC connectivity to the left caudate (r=0.55, p=0.00006, corrected for multiple comparisons) and inversely correlated with right ACC connectivity to the left medial frontal gyrus (r=-.64, p=0.000001, corrected for multiple comparisons). Controls showed no significant correlations between task performance and connectivity measures.

I45

GENERAL COGNITIVE ABILITY (G): A CENTRAL ROLE FOR EXECUTIVE FUNCTION Kanchna Ramchandran[1], Eugene Zeien[1], Nancy Andreasen[1]; [1]University of Iowa — Current theories propose overall lower cortical resource consumption in efficient cognitive performance, while we hypothesize a more complex, executively distributed mechanism of resource allocation. In order to identify a potential, neurally efficient, distributed mechanism in the brain that processes "g", we functionally neuroimaged 22 individuals (Age : M=36.77yrs, SD=13.23; Gender: 12M, 10F) with average intelligence (Mean Full scale IQ =114, SD=14) while solving the Raven's advanced progressive matrices (RAPM) and a simple pattern matching control task. Whole brain analyses (contrast of RAPM vs. control) reveals a significant (p=0.05) increase in BOLD response at the superior parietal lobule (BA 7). This is accompanied by a concurrent significant suppression of the left lingual gyrus (BA 39) and the bilateral fronto-polar regions (BA 10), extending into the rostral anterior cingulate (acc). We argue that the RAPM (a visuospatial, cognitive, measure), is processed primarily in the precuneus/superior parietal executive hub, critical to error processing in visuospatial decisions, while the frontal (no longer necessary) and lingual gyrus (may interfere with error processing) hubs are silenced to perhaps maximize neurophysiological resources at the critical processing region (BA 7). We conclude that this distributed oscillatory mechanism of activation and suppression of various executive hubs may represent a unique and novel example of neural efficiency in the processing of "g". This could represent self-organizing, small-world, complex, adaptive executive function networks that may toggle on and off based on the nature and complexity of the task and customized allocation of cortical resources required to succeed in the real world.

I46

TEMPORAL PREDICTION ERRORS ANTICIPATORILY MODULATE CINGULATE-INSULAR CONNECTIONS Roberto Limongi[1], Steven Sutherland[2], Jerry Zhu[2], Michael E. Young[2], Reza Habib[2]; [1]Venezuelan Institute for Scientific Research, [2]Southern Illinois University Carbondale — Anticipatory activity in the anterior middle cingulate cortex (aMCC) and in the anterior insula (aINS) is associated to prediction error likelihood. We propose a mechanistic model of the aMCC-aINS system upon which the simultaneous error-likelihood-driven anticipatory activity would rest. Fifteen participants were scanned in an MRI system when performing a temporal prediction task. They observed visual animations and predicted when a stationary ball would move after being touched by a moving ball. Three spatial gaps and three temporal delays between the balls introduced uncertainties thus inducing prediction errors. BOLD responses were modeled within the general linear model approach. We used a dynamic causal model approach to infer unobserved neuronal states within the aMCC and the aINS and the modulation of their connections in which task would drive activity in the aINS and the prediction errors would modulate cingulate-insular connections. Eight additional competing models were included. The model comprising driving inputs to the aINS and modulatory inputs to the forward cingulate-insular connections yielded the highest exceedance probability. Task-related driving activity in the aINS was positive and prediction-error related signals negatively modulated aMCC-aINS forward connections. The aMCC-aINS system not only responds anticipatorily when humans predict whether an event occurs but also when it is to occur. Our mechanistic model is a natural extension of the previously shown error-dependent coactivation of the aMCC-aINS system. Our results open at least two questions: First, which region originates the modulatory signals? Second, does this prediction error signal drive learning-related synaptic plasticity in the aMCC-aINS connections?

I47

ERP INVESTIGATION OF TEMPORAL AND SPATIAL DEVIATION PROCESSING IN NEWLY LEARNED NAVIGATION ROUTES Elisabeth Ploran[1], Sujala Maharjan[2], Emily Urban[3], David Hawkins[1], James C. Thompson[1]; [1]George Mason University, [2]Wesleyan College, [3]Marquette University — As we navigate through the environment, we are constantly using information about both the spatial context and the temporal sequence of our movement. Learning both types of associations in a new environment may contribute to our ability to navigate flexibly. Our study assessed the ability to identify temporal and spatial deviants during passive navigation through a recently learned environment. Participants were familiarized with two routes through a commercial district. They were then asked to indicate whether sequences of images were intact (all from the same route in the correct order), spatial deviants (one image was from the other route), or temporal deviants (all from the same route, but two reversed in order). Event-related potentials (ERPs) were recorded simultaneously with behavioral performance. The behavioral data indicate that although participants sometimes labeled spatial deviants as temporal deviants, thus still indicating recognition of a deviation, the reverse was not true. When participants mislabeled a temporal deviant, it was most likely labeled "intact", suggesting difficulty in identifying temporal deviations. In addition, ERP analysis of correct trials demonstrated a strong N200 response in frontal electrodes to spatial deviants compared to intact trials. Interestingly, this N2 response was only found for the second image of the reversed order sequence. The first image, which skipped ahead along the route, was associated with a similar ERP response as intact trials. The results suggest that although both temporal and spatial information are available in newly learned environments, reactions to temporal deviations are most pronounced when time appears to reverse.

I48

THE DEFAULT AND EXECUTIVE NETWORKS DEMONSTRATE TASK-DEPENDENT AND TASK-INDEPENDENT PATTERNS OF FUNCTIONAL CONNECTIVITY Matt Dixon[1], Melissa Ellamil[1], Kieran Fox[1], Kalina Christoff[1]; [1]University of British Columbia — The brain is organized into several coherent networks that can be reliably identified during rest and during task performance. Using seed regions from the default and executive networks, we examined functional connectivity during rest and during 5 different tasks and looked for task-dependent and task-independent patterns of functional connectivity. Preliminary analyses provide evidence for both types of patterns. The core regions comprising the default network [posterior cingulate cortex (PCC), medial prefrontal cortex (MPFC) and inferior parietal cortex (IPL)] and core regions comprising the executive network [lateral prefrontal cortex (lPFC), anterior midcingulate (aMCC), and intraparietal sulcus (IPS)] remain functionally connected independent of task. However, connectivity with other regions shows some degree of task specificity. For instance, the PCC seed from the default network exhibits relatively greater connectivity with the dorsolateral prefrontal cortex during a creativity task, whereas the lPFC seed from the executive network shows relatively greater connectivity with the striatum during a cognitive control task. These data suggest that while network functional connectivity adapts to external demands, a high degree of consistency is present.

I49

A COMPUTATIONAL MODEL OF RULE-GUIDED BEHAVIOR IN THE PREFRONTAL CORTEX Ashley N. Cline[1], Jeremy R. Reynolds[1]; [1]University of Denver — Rule-guided behavior is a major component of cognitive control. One important question regarding rule-guided behavior is how rules are represented and developed. Recent work has shown that rule-like representations can be developed in neural networks that have the ability to actively maintain information and rapidly update such information when necessary (Rougier, Noelle, Braver, Cohen, and O'Reilly, 2005). The current study extends this previous work by investigating how such abilities may occur via hypothesized interactions between the prefrontal cortex (PFC) and basal ganglia (BG; O'Reilly & Frank, 2006). In particular, the previous models used a very rigid and specific updating mechanism, and the goal of the current set of simulations was to investigate whether a more general-purpose, flexible mechanism could account for similar phenomena. As in Rougier et al., the current models are trained on several different task rules that require the model to respond on the basis of a relevant dimension. Critically, several stimuli are left out of training, and are subsequently used to test how general-purpose the developed rule representations are. We replicate prior results across a number of control networks, and demonstrate that the more flexible updating mechanism has both strengths and weaknesses relative to the more rigid updating mechanism used previously.

I50

PERCEIVED OBJECT OWNERSHIP BIASES REWARD EVALUATION WITHIN MEDIAL-FRONTAL CORTEX Olave Krigolson[1], Cameron Hassall[1], David Turk[2]; [1]Department of Psychology and Neuroscience, Dalhousie University, [2]Department of Psychology, University of Aberdeen — Recently it has been established that ownership of an object biases perceptual processing (Turk et al., submitted). Specifically, Turk and colleagues found perceived self-ownership was associated with increased perceptual processing. Here, we sought to determine whether or not perceived object ownership would bias the output of the medial-frontal reinforcement learning system (Holroyd & Coles, 2002; Krigolson et al., 2009). Specifically, we used event-related brain potentials (ERPs) to examine whether or not the amplitude of the feedback error-related negativity (fERN; Miltner et al., 1997) was modulated by perceived object ownership. Participants completed a gambling task in which they either won or lost objects that were presented to them on a monitor. In an important manipulation, objects were presented in conjunction with a cue that indicated whether or not the participant or someone else would win or lose the object as a result of the gamble. As with Turk and colleagues, we found that objects associated with self-ownership evoked a larger P300 component. Further, we found that the amplitude of the fERN was reduced for other-ownership as opposed to self-ownership gambles. Our results confirm Turk and colleagues finding that perceptual processing is sensitive to object ownership. Further, our results demonstrate that the medial-frontal reinforcement learning system is sensitive to perceived object ownership.

I51

DOSE DEPENDENT DOPAMINERGIC MODULATION OF REWARD-BASED LEARNING IN PARKINSON'S DISEASE Nelleke C. van Wouwe[1,2], Richard K. Ridderinkhof[4,5], Guido P.H. Band[2], Wery P.M. van den Wildenberg[4], Scott A. Wylie[3]; [1]TNO Behavioral and Societal Sciences, Soesterberg,the Netherlands, [2]Leiden Institute for Brain and Cognition, Leiden University, Leiden, the Netherlands, [3]Vanderbilt University, [4]Amsterdam center for the study of adaptive control in brain and behaviour (Acacia), University of Amsterdam, Amsterdam, The Netherlands, [5]Cognitive Science Center Amsterdam, University of Amsterdam, Amsterdam, The Netherlands — Learning the most adaptive behavior in novel situations is an essential aspect of life that requires the ability to quickly associate stimuli with actions that optimize rewarding outcomes. Animal electrophysiology and human fMRI studies converge on the notion that different aspects of this reward-based learning process can be linked to dissociable corticostriatal circuitries. Specifically, the processing of mismatches between actual reward and anticipated reward early in the course of learning is linked to ventral striatum and associated frontal circuitry, whereas the formation of stimulus-action-reward associations is linked to the anterior putamen and associated motor circuitry late in learning. Dopaminergic (DA) innervation of these circuitries is well established; however the modulatory role of DA on these stages of reward-based learning remains to be fully elucidated. Using a mathematical model of these learning processes, we studied the modulatory role of DA in patients diagnosed with Parkinson's disease (PD) who performed a probabilistic reward learning task both on and off of their dopamine medication. Compared to the off medication state, low and moderate doses of dopamine medication had no impact on the early, outcome evaluation phase of learning, but significantly improved the proficiency of learning stimulus-action-reward associations. This suggests a dopaminergic modulation of learning supported by the anterior putamen and associated motor circuitry. Importantly, high doses of dopamine produced increased reward prediction errors, suggesting that too much dopamine may interfere with ventral striatal circuitry involved in early outcome evaluation learning processes.

I52

ALTERED DEFAULT MODE NETWORK FUNCTIONAL CONNECTIVITY DURING THE RESTING STATE IN LONG-TERM MEDITATION PRACTITIONERS Kieran C.R. Fox[1], Matthew L. Dixon[1], Melissa Ellamil[1], Kalina Christoff[1]; [1]University of British Columbia — Recent years have seen a surge of interest in the default-mode network (DMN), a diverse web of brain regions showing strong functional connectivity (FC) in fMRI studies when the brain is in its 'resting' state. DMN regions include posterior cingulate cortex (PCC), medial prefrontal cortex (mPFC), and the hippocampus (HC). The DMN is thought to support spontaneous thought and mind-wandering: ruminations on past and/or potential future experiences, fantasizing, and a running self-narrative – a picture generally consistent with the regions showing strong activation and connectivity during the resting state. The explicit goal of many contemplative (meditation) practices is to quiet the stream of thoughts, associations, memories and fantasies which occupy much of our waking life and may be mediated at the neural level by DMN activity – and instead attend to the present moment of experience. To test the hypothesis that experienced meditation practitioners would show altered DMN activity, we examined 7-min epochs of eyes-closed resting state fMRI data in long-term meditation practitioners (mean experience ~6000 hrs). We chose a central region of PCC as the FC seed region, as PCC is the most commonly reported DMN node. Compared to connectivity measures in normal subjects, meditators showed decreased connectivity between PCC and HC, and a shift in connectivity from typical ventral mPFC regions to more dorsal regions of the anterior cingulate. Our results suggest that long-term meditators show altered DMN activity during rest that may represent a shift away from long-term memory and fantasizing toward a more present-centered attentional stance.

LANGUAGE: Other

I53

INVESTIGATING THE USE OF LEFT AND RIGHT-LATERALIZING TDCS FOR REHABILITATION OF NAMING IN APHASIA Elizabeth H. Lacey[1], Brenda Rapp[2], Tracy D. Vannorsdall[1], David J. Schretlen[1], Barry Gordon[1]; [1]The Johns Hopkins University School of Medicine, [2]The Johns Hopkins University — Some encouraging results have been reported after anodal transcranial direct current stimulation (tDCS) targeting regions in the left hemisphere (LH) in people with chronic aphasia (e.g., Fridriksson et al., 2011). However, the optimal electrode positioning and polarity for enhancement of language skills remains to be determined. We report naming data before and after left-lateralizing, right-lateralizing and sham stimulation in two people (Patient 1 (P1) and Patient 2 (P2)) with chronic post-stroke naming deficits. P1's lesion encompasses mostly frontal areas while P2's lesion is fronto-temporal. During left-lateralizing tDCS, participants

practiced naming pictures (with phonological and orthographic cues) for 30 minutes, at 2 mA, with the anodal electrode over left Broca's area and the cathodal over the right hemisphere (RH) homologue (similar to the configuration in Turkeltaub et al., 2011). In the right-lateralizing condition, electrode polarities were reversed (anodal, RH; cathodal, LH). Each condition was administered for two consecutive days. Results show no change in naming accuracy after tDCS in P1. For P2, naming accuracy did not differ from baseline after left-lateralizing tDCS or sham (McNemar p=.227 and p=1.000, respectively), but did improve after right-lateralizing tDCS (McNemar p=.012). There is evidence that residual language skills in individuals with aphasia originate from left perilesional areas in most individuals, although there is also some evidence that residual capabilities can arise from the RH. The current study, the first we know of to investigate anodal stimulation to RH, indicates that individual differences in the anatomical origin of residual language capabilities may determine optimal stimulation parameters.

I54

CLASSIFICATION OF WORDS AND SYLLABLES: A P3 ERP STUDY. Nicholas Walker[1], Phillip M. Gilley[1]; [1]University of Colorado at Boulder — This study sought to compare classification of words and syllables using the P3 response of the auditory event related potential (ERP) as an index of speed of classification. In this study, we measured ERPs and behavioral reaction times to auditory stimuli consisting of three-phoneme words (e.g. /bæd/) and two-phoneme syllables (e.g. /bæ/) in ten young adults. Stimuli were presented in an auditory odd-ball paradigm under two experimental conditions (words-rare and syllables-rare), presented monaurally and repeated in each ear. Using planned comparisons on the PZ electrode, and controlling for ear, condition was a significant predictor of latency with earlier P3 latencies in the words-rare condition. This is consistent with the behavioral data revealing faster responses to words than to syllables. The interaction of ear and condition was significant with participants having earlier P3 latencies on average in their left ear in the syllables-rare condition, and earlier P3 latencies on average in their right ear in the words-rare condition. The right ear advantage was present in the P3 response to words; however, the response to syllables did not show this advantage. The difference in P3 latencies suggests that classification occurs faster for words than for syllables, and may suggest that the latency of the P3 response reflects the behavioral relevance of the stimulus.

I55

THE BILINGUAL AND MONOLINGUAL DIFFERENCES IN COMPREHENSION PROCESSING: AN FMRI STUDY ON GRAMMAR AND SEMANTIC VIOLATION IN SENTENCES. Patricia Román Fernández[1], Aina Rodríguez-Pujadas[2], Noelia Ventura-Campos[2], Ana Sanjuán[2], Julio González[2], César Ávila[2]; [1]Max Planck Intitute, [2]Universitat Jaume I — The development of neuroimaging techniques together with the growing interest in the effect of bilingual experience have increased knowledge about neural differences in the bilingual brain. Wartenburger, Heekeren, Abutalebi, Cappa, Villringer, and Perani (2003), found that early bilinguals activated the prefrontal cortex to a higher extent in L2 grammatical judgment rather than in semantic but not late bilinguals. This can be interpreted in terms of the declarative/procedural model of language (Ullman, 2004) where grammatical rules are dependent on implicit knowledge sub served by frontal areas and basal ganglia. Late L2 acquisition would not rely on the same structures as it would be acquired explicitly. To test this hypothesis, in the present study we wanted to explore whether grammatical and semantic processing in bilinguals differ in L1 too. An fMRI study was conducted where 23 bilinguals and 20 monolinguals performed a grammatical and semantic judgment task. We observed a more extensive activation of the bilingual brain in grammatical and semantic judgment. More interestingly, higher activation of LIFC for L1 grammatical jugdments than semantic was found in bilinguals and specially in less proficient. These results are in agreement with those observed for L2 processing in other studies, thus suggesting that bilinguals recruit a more extensive network than monolinguals in L1 too. However, this results question the interpretation based on the declarative/procedimental model, or at least suggest that L2 processing influences performance in L1.

I56

OVERLAPPING AND UNIQUE NEURAL SUBSTRATES FOR NARRATIVE PRODUCTION AND COMPREHENSION: AN FMRI STUDY Nuria AbdulSabur[1,2], Yisheng Xu[1], Ho Ming Chow[1], Allen Braun[1]; [1]National Institute On Deafness and Other Communication Disorders, National Institutes of Health, [2]University of Maryland, College Park — While most language communication happens at the discourse level and includes both comprehension and production, most neuroimaging research either examines comprehension and production in separate studies or focuses on language processing at lower levels, e.g. single words and sentences. In the current study, we aim to 1) identify regions that are either shared or uniquely associated with discourse comprehension and production and 2) examine the functional connections between these regions and other cortical areas. Eighteen right-handed individuals, underwent functional magnetic resonance imaging while listening to and telling short narratives. Our results indicate that narrative comprehension and production share neural correlates in the left inferior frontal gyrus (IFG) and posterior temporal regions, as well as fusiform, anterior temporal, inferior parietal, and medial prefrontal cortices. However, we also found unique activations for each: narrative comprehension is more bilateral, e.g. activating the right IFG and temporal cortex, while narrative production uniquely engages a diverse array of cortical and subcortical structures. Additionally, comprehension and production exhibit disparate connectivity patterns, even when the seeds regions are selected from areas of shared activity. For example, the left IFG is connected with the supplementary motor area and basal ganglia during production; while during comprehension, this region is connected to auditory and visual cortices. Interestingly, seed regions are consistently connected to anterior brain regions during production, and to more posterior regions during comprehension. While narrative production and comprehension share core anatomical features, they are also characterized by unique neural correlates and patterns of functional connectivity.

I57

THE EVENT-RELATED OPTICAL SIGNAL (EROS) REVEALS PATTERNS OF HEMISPHERIC PROCESSING DURING LANGUAGE COMPREHENSION Edward W. Wlotko[1], Kara D. Federmeier[1], Monica Fabiani[1], Gabriele Gratton[1]; [1]University of Illinois — Hemispheric specialization has been examined with visual half-field techniques (presentation of stimuli in one half of the visual field, stimulating and biasing processing to the contralateral hemisphere) in conjunction with neurophysiological or behavioral responses. A major assumption of these techniques is that hemispheric biases remain after initial visual processing, which is difficult to verify with most methodologies. The event-related optical signal (EROS) is uniquely suited to provide a window into hemispheric asymmetry and cooperation, as it allows interrogation of the timecourse of activity within localized cortical areas. To examine contralateral and ipsilateral activity associated with language processing, EROS was recorded while participants read sentences presented word-by-word in the center of the screen, with the sentence-final word randomly presented in central, left, or right visual field (CVF, LVF, or RVF). Lateralized stimulation elicited contralateral activity in left and right inferior frontal gyrus approximately 310-385 ms post-stimulus onset. Stimulus-locked averages showed little contralateral activity in temporal areas. Cross-correlation analyses (a measure of functional connectivity) revealed bilateral fronto-temporal within-hemisphere correlations, for all presentation conditions (CVF, LVF, RVF). Temporal activity lagged frontal activity by 95-195 ms in the LH and 215-330 ms in the RH. Taken together, these results provide evidence that processing biases produced by half-field presentation persist after initial visual processing. Further, intrahemispheric circuits seem to be engaged regardless of initial stimulation. These circuits appeared faster and more robust in the LH than in the RH, concurring

with claims of stronger or more efficacious top-down language mechanisms in the LH.

I58

NEURAL CORRELATES OF VISUAL LETTER IMAGERY IN TYPICALLY DEVELOPING READERS Raj Stewart[1], Aparna Pisupati[1], Scott Burns[1], Nikki Davis[1], Sheryl Rimrodt[1], Laurie Cutting[1]; [1]Vanderbilt University — Word recognition has been established as an important component in reading, and previous work has identified multiple neural regions active during word recognition tasks. However, less is known about regions involved in processing single-letters, including during letter imagery, a clear component of word recognition. The present study used an fMRI paradigm to examine minimum neural correlates of visual letter imagery, and the hypothesis that correlates of letter processing are similar to those active in word recognition. Twenty-three adults with normal or corrected-to-normal visual acuity completed two runs (96 total trials) of a letter imagery task. During each trial, participants first saw a block representation of an English letter. On half of the trials ("control"), participants then saw a grid with a transparent version of the letter, along with a target 'X'; on the other half ("imagery"), participants were only shown the target 'X'. For all trials, participants were instructed to indicate whether the target's location overlapped a grid space previously occupied by the letter. Comparing imagery > baseline and imagery > control conditions in whole brain analysis, we found that regions in middle and superior frontal gyrus, fusiform gyrus, and precuneus were active during letter imagery, with precuneus and middle frontal gyrus displaying differentially greater activation for imagery > control. These findings provide evidence that single letter processing activates similar areas as word recognition; however, additional regions are recruited specifically for imagery. Findings also suggest that this may be a relevant experimental task for investigating networks involved in word recognition.

I59

SPATIALLY SEPARABLE NETWORKS FOR OBSERVED MOUTH AND GESTURE MOVEMENTS DURING LANGUAGE COMPREHENSION Jeremy Skipper[1], Jason Zevin[2], Sarah Kane[1], Megan Calabrese[1]; [1]Hamilton College, [2]Weill Medical College of Cornell University — Most neurobiological language research discards "context" in favor of studying isolated speech sounds or words. We test an alternative model in which language engages multiple brain networks in a context-dependent manner. We tested this model with source localized high-density encephalography (EEG) and functional magnetic resonance imaging (fMRI) with both naturalistic and controlled stimuli. When participants watched a television game show, both EEG and fMRI revealed that speech-associated mouth movements and co-speech gestures were processed in spatially separable ventral and dorsal pathways. The ventral "mouth" regions included posterior superior temporal (ST), inferior parietal, and ventral premotor (PM) cortex. The dorsal "gesture" regions included anterior ST, superior parietal, and dorsal PM cortex. In the controlled study, participants watched an actress speaking sentences that were constructed to vary on the informativeness of mouth movements (more or less visible) and co-speech gesture (none or more or less imagistic). Preliminary results suggest that mouth and gesture movements were associated with their own ventral and dorsal networks. Functional connectivity analyses show that when mouth movements were more informative, the ventral network was weighted more strongly whereas when gestures were more informative, the dorsal network was weighted more strongly. Results suggest that the organization of language in the brain is not static but, rather, is supported by multiple, distributed, and simultaneously active networks each processing a different type of context, weighted by the informativeness of different sources of information in the environment.

I60

CHARACTERIZING DISCOURSE LEVEL LANGUAGE DEFICITS IN "WELL-RECOVERED" POST-STROKE APHASIC PATIENTS Stephanie Bissonnette[1,2], Meghan Healey[1], Jennifer Ryder[3], Ho Ming Chow[1], Siyuan Liu[1], Yisheng Xu[1], Beth Solomon[3], Allen Braun[1]; [1]The National Institute on Deafness and Other Communication Disorders, The National Institutes of Health, [2]University of New England College of Osteopathic Medicine, [3]Rehabilitation Medicine, The National Institutes of Health — Although real world communication exists predominantly at the discourse level, language in this context is largely ignored in the assessment of post-stroke aphasia. Yet among the patients in our clinic, a large number of "well-recovered" aphasics (i.e. those without sentential or lexical deficits) report continued struggles in daily functioning and communication despite scoring well on classic tests of aphasia. The current study is an attempt to characterize this population by comparing the performance of 15 post-stroke aphasic patients with left sided lesions to a set of age-matched controls. All patients scored above an 88 on the Western Aphasia Battery Aphasia Quotient and within normal ranges on lower level tasks including object naming, sentence completion, and word finding. The administered discourse battery included tasks such as story comprehension and retell, picture description, sequencing, and inferencing. Measures of working memory and attention were also obtained. Analysis of variance (ANOVA) revealed significant between-group differences in several elements of discourse level processing, notably organizing a coherent story structure, recalling details of a story, and building inferences from implicit information. Furthermore, voxel-based lesion symptom mapping (VLSM) identified an association between damage to frontal regions anterior and superior to the inferior frontal gyrus and discourse level impairments. In total, these data reveal (1) a need for improved assessment tools for aphasia, (2) the need for continued monitoring of discourse performance for patients with lesions extending into the frontal cortex, and (3) a role for rehabilitation services that seek to improve communication at the discourse level.

I61

ELECTROPHYSIOLOGICAL CORRELATES OF AUDIOVISUAL SPEECH PERCEPTION IN AUTISTIC CHILDREN Yang Zhang[1], Tess Koerner[1], Meri Naumceska Blumenkron[2], Erin Diamond[1], Edward Carney[1]; [1]1Department of Speech-Language-Hearing Sciences, University of Minnesota, [2]Berlin School of Mind and Brain, Luisenstraße 56, Haus 1, 10099 Berlin, Germany — The ability to detect auditory-visual correspondences in speech is an early hallmark of typical language development in infancy. This event-related potential study examined the individual differences in bimodal speech perception in children (5~10 years old) clinically diagnosed with autism. The stimuli consisted of two vowels, /i/ and /a/, produced by a male speaker. Congruent and incongruent matchup conditions for the auditory and visual information were digitally created to examine the detection of incongruency in the individual subjects. Among the ten subjects, four children showed no significant waveform differences between the congruent and incongruent conditions, and the other six showed significant incongruency effect. The latency of incongruency detection responses in the autistic children appeared similar to that of 5~11 month old infants. Minimum norm estimation results showed significant activities in the right superior temporal and parietal regions for the incongruency effect. The results suggest the lack of homogeneity in audiovisual integration for speech perception in autistic children, which cannot be easily predicted from behavioral measures.

I62

EMOTIONS SPEAK LOUDER, THEN WORDS: NON-VERBAL EMOTIONAL CUES PREDICT FORTHCOMING WORDS Amanda O'Brien[1], Jeremy Safran[1], Jeremy Skipper[1]; [1]Hamilton College — The study of language and the brain has largely proceeded as if non-verbal expressions of emotion are independent of spoken language. We tested an alternative interactive perspective, i.e., that non-verbal emotional displays are used to predict forthcoming words. Participants watched videos of two people having a conversation. One talker displayed an emotion on the face (e.g., a smile) or a neutral face. The other talker then asked a question (e.g., "How did the interview go?"). The final word of the reply was more or less predictable based on the prior facial display (e.g., "It went well"). Using source localized high-density encephalography, we found that the reply, prior

to the final word, resulted in more activity in auditory and motor areas for initially valenced compared to neutral facial expressions. The final word of the reply resulted in more amygdala and little other activity for the same comparison. In contrast, the final word resulted in more auditory and motor area activity for initially neutral compared to valenced facial expressions. Taken together, these results suggest that the amygdala aids in the pre-activation of a neighborhood of words associated with emotional facial expressions that can be used to constrain the prediction of subsequent words by the motor system. This prediction frees up brain resources that might be used for other purposes. This implies that the division between non-verbal and verbal information is blurry and that a full understanding of language and the brain requires that we study how these forms of communication interact.

LONG-TERM MEMORY: Episodic

I63

BRAIN SIGNAL VARIABILITY IN AUTOBIOGRAPHICAL MEMORY AND REST: A MEG STUDY Jennifer Heisz[1,2], Brian Levine[1,2], Bernhard Ross[1,2], Anthony R. McIntosh[1,2]; [1]Rotman Research Institute at Baycrest, [2]University of Toronto — Complex cognitive operations like autobiographical memory emerge from integrative dynamical activity across widespread networks. Critically, such operations reflect coordinated processes that unfold over time rather than a particular state of function. Information theoretic metrics, like multiscale entropy (MSE), quantify brain signal variability over time at multiple timescales and therefore could capture the dynamics of neural network activity. The present study used MSE to quantify the spatial-temporal variability of human neuromagnetic brain signals while individuals listened to audio recordings of past autobiographical episodic and semantic events. Detail-rich episodic autobiographical memories evoked more brain signal variability than semantic memories. Moreover, this difference in variability was observed at brain regions that are commonly active during both episodic and semantic tasks. When contrasting the variability of brain signals during the cued memory conditions versus rest greater variability was associated with memory conditions at brain regions common to both memory and rest. The results suggest that entropy measures provide an important marker of network dynamics and a way to dissociate cognitive operations even when similar brain regions are recruited for processing.

I64

ASSESSING MEMORY STRATEGIES USING COMPUTATIONAL CLASSIFICATION OF EVENT-RELATED POTENTIALS Laura Matzen[1], Michael Haass[1]; [1]Sandia National Laboratories — Although there are many strategies and techniques that can improve memory, people often use suboptimal memory strategies. Our goal in this study was to use event-related potentials (ERPs) recorded during a memory task to assess whether or not participants were using an effective memory strategy. We predicted that participants with ERPs that were consistent with an effective memory strategy would perform better at test than other participants. In the memory task, some words were studied once, some were studied twice, and some were studied once then followed with a quiz-like memory test. All of the words were subsequently tested or retested. On average, participants had the best memory performance for words that were quizzed during study. The quizzed words elicited a large late positive component (LPC), an ERP that has been associated with explicit memory search processes. We hypothesized that some participants would adopt a self-quizzing strategy for the study words that were not explicitly quizzed. This strategy should lead to larger LPCs in response to the studied words and to better memory at test. We developed a computational model that characterized the brain activity associated with passive study and with explicit memory testing. We then used that model to predict which participants adopted a self-quizzing strategy during the study sessions and which did not. Finally, we evaluated the behavioral performance of the two groups of participants. This analysis revealed that, as predicted, the participants whose brain activity was consistent with a self-quizzing strategy had better memory performance at test.

I65

ROLE OF LEFT PARAHIPPOCAMPAL GYRUS IN EPISODIC AND SEMANTIC FAMILIARITY Sasha Cervantes[1], Jessica Wong[1], Ian McDonough[2], Patrick Dolan[3], David Donaldson[4], David Gallo[1]; [1]University of Chicago, [2]University of Texas at Dallas, [3]Drew University, [4]University of Stirling — In recognition memory, words can feel familiar not only because they were recently encountered in an experiment (episodic familiarity), but also because they have high pre-experimental or baseline frequency (semantic familiarity). Here we investigated the neural correlates of these two factors by crossing study repetitions at encoding with baseline word frequency, and then using event-related fMRI during a recognition memory test with recollect/familiar judgments. Behavioral results confirmed that both study repetition and word frequency enhanced familiarity estimates, and also revealed a word-frequency mirror effect in recollect judgments. An unbiased whole-brain analysis on studied items revealed that activity in the left parahippocampal gyrus, a region sometimes associated with familiarity, interacted with repetition and frequency. Specifically, this region showed greater activity for high frequency words compared with low frequency words, and this difference was greatest for items that were repeated at study. These results suggest that this region is sensitive to the effects of both episodic and semantic information when experiencing a feeling of familiarity at retrieval, with implications for dual process theories of recognition memory.

I66

THE ENCODING AND RETRIEVAL NEURAL MECHANISMS SUPPORTING TEMPORAL AND SEMANTIC CLUSTERING IN FREE RECALL Nicole M Long[1], Michael J Kahana[1]; [1]University of Pennsylvania — In freely recalling lists of items, people exhibit two striking forms of clustering: temporal clustering in which items studied in neighboring positions are recalled successively, and semantic clustering in which items with similar meanings are recalled successively. There is growing evidence that differential encoding mechanisms support temporal and semantic clustering during recall. Less evidence exists on what mechanisms underlie these forms of organization during the retrieval period. To examine encoding and retrieval processes supporting organization during recall, we conducted an experiment in which items of varying semantic similarity were studied in either adjacent or widely spaced list positions. We then examined the degree to which the spectral features of the scalp EEG could distinguish between encoding and retrieval of successfully (1) recalled items, (2) semantically clustered items, and (3) temporally clustered items. Behaviorally, semantic and temporal clustering are positively correlated with successful recall while negatively correlated with each other. The neural results of encoding show similar patterns for items subsequently recalled and items subsequently semantically clustered, specifically decreases in theta, alpha and beta power. The most robust temporal effect is an increase in alpha power for subsequently temporally clustered items. Preliminary results during retrieval show theta power decreases and gamma power increases during successful recall. These results suggest a shared encoding and retrieval mechanism characterized by changes in low frequency power with the potential for a retrieval-specific mechanism characterized by change in high frequency power.

I67

NEURAL SIMILARITY BETWEEN ENCODING AND RETRIEVAL PREDICTS ITEM-SPECIFIC VARIATION IN MEMORY SUCCESS Maureen Ritchey[1,2], Erik A. Wing[1], Kevin S. LaBar[1], Roberto Cabeza[1]; [1]Duke University, [2]University of California, Davis — A central hypothesis in memory research is that memory is a function of the similarity between encoding and retrieval operations. Several neurocomputational models of memory have likewise proposed that the hippocampus is involved in reinstating neocortical representations of prior experiences at the time of retrieval. However, it has remained a challenge to characterize the reactivation of individual

memory representations in humans. To this end, fMRI data were collected during the encoding and recognition of emotionally arousing and neutral scenes. Beta patterns corresponding to each individual trial were extracted from a set of anatomically-defined ROIs, and neural similarity between encoding and retrieval patterns was evaluated for each possible encoding-retrieval pair. We found evidence for enhanced encoding-retrieval similarity for successfully remembered trials versus forgotten in several cortical regions of interest; a subset of these regions (especially within occipito-temporal cortex) was particularly sensitive to the reactivation of item-specific information. Critically, hippocampal activation mediated the relationship between encoding-retrieval similarity and memory on a trial-to-trial level, underscoring its participation in facilitating cortical reactivation during retrieval. Consistent with the modulatory influence of emotional arousal on memory, emotional items were associated with enhanced encoding-retrieval similarity, particularly within middle occipital gyrus. This study presents novel evidence that memories are tied to encoding-retrieval similarity at the level of the individual item, and that memory reactivation can be modulated by emotion. Successful memory reactivation is linked to hippocampal-cortical interactions, confirming predictions from neurocomputational models. These findings speak to the promise of pattern similarity measures for evaluating individual memory representations.

I68

THE GENERATION EFFECT AND STRATEGIC RETRIEVAL IN REALITY MONITORING

Timm Rosburg[1], Mikael Johansson[2], Axel Mecklinger[1]; [1]Saarland University, [2]Lund University — Reality monitoring represents a special case of source monitoring which requires the differentiation between perceived and imagined events or between own actions and actions of second persons. The role of control processes in reality monitoring is yet not fully understood. In our current study, we investigated such control processes (in the form of retrieval orientation and strategic retrieval of nontarget information) by event-related potentials (ERPs). Complete or incomplete object words were presented in sentences. Participants had to identify the words as the subject of the sentence (perceive condition) or had to complete them (generate condition). The participants' memory accuracy was better for generated items than for perceived items, as tested in a subsequent memory exclusion task. Comparison of ERPs to new items between the two target conditions (i.e. assessing retrieval orientation) showed more positive ERPs when generated object names were targeted. Nontarget retrieval (as reflected in a left-parietal old/new effect to nontargets) was observed only for generated items which were more easily retrieved than perceived items. Current findings are in line with the assumption that retrieval orientation in reality monitoring is supported by prefrontal brain structures. The occurrence of a left-parietal old/new effect to nontargets when the hard to retrieve perceived items were targeted corroborates the concept that the ease with which items can be accessed promotes nontarget retrieval.

I69

LAUGH YOURSELF TO SLEEP: THE ROLE OF HUMOR IN THE INVESTIGATION OF SLEEP'S EFFECTS ON POSITIVE MEMORY

Alexis Chambers[1], Jessica Payne[1]; [1]University of Notre Dame — Numerous studies have examined sleep's influence on emotional memory formation. Most of these studies have focused solely on memory for negative material, or have grouped positive and negative material together to investigate the differential impact of sleep on "emotional" versus neutral memory. Yet the question of how sleep specifically impacts positive memory formation remains unanswered. The present study investigated the role of humor as a strong positive emotional stimulus in sleep-dependent memory consolidation, as studies have more consistently found enhanced memory for humorous over non-humorous material. Participants (N=66) incidentally encoded 27 Farside cartoons that appeared in either their original humorous version or were altered into non-humorous versions. Subjects freely recalled the cartoons following a 12-hour delay across a period of either wake or sleep. Results indicate that humor enhanced later recall overall, with subjects recalling more humorous cartoons than non-humorous ones ($F = 5.33$, $p < .001$). Although sleep had no effect on the type of cartoons recalled, there was a significant impact of sleep on the number of memory distortions present when recalling the cartoons. Specifically, subjects in the wake group exhibited greater mixing of features among cartoons ($t = 2.16$, $p = .035$), implying a subtle impairment in memory accuracy. These results suggest that the short-term memory humor effect found in previous studies is robust across a longer, 12-hour delay. Further, sleep appears to offer some protection to the integrity of memories over this delay.

I70

AN FMRI STUDY OF THE NEURAL CORRELATES OF RECOGNITION MEMORY STRENGTH FOR ITEM AND RELATIONAL INFORMATION

Yi-Chieh Chiu[1], Brian Gonsalves[1]; [1]University of Illinois — Research has identified functionally dissociable regions within the medial temporal lobes that support different aspects of recognition memory. Item memory tends to be associated with graded deactivations at retrieval in perirhinal cortex (PRc) as a function of memory strength. Relational memory, which supports recollection, has been associated with activations in hippocampus (Hc) and parahippocampal cortex (PHc) that seem not to be graded with memory strength. Typically investigations of this issue use participants' confidence as a proxy for memory strength and measure fMRI activity in the MTL as a function of recognition confidence. This is potentially problematic as may not be a straightforward mapping from memory strength to subjective confidence. The present study aimed to experimentally manipulate item and relational strength by varying encoding repetitions of elements within face-scene pairings. Some faces were presented alone 1 or 2 times before being shown once with a scene, to vary item strength while holding relational memory constant. Variations in relational strength were created by presenting faces with their associated scenes either 1, 2 or 3 times. Functional MRI data collected during recognition revealed an area in PRc that showed decreasing activation with increasing face repetition, independent of face-scene pairings. On the other hand, an area in PHc showed increasing activation with increasing face-scene pair repetition. These finding supports theories that posit dissociations among regions that represent item and relational memory, and further, reveals regions that track gradations in relational memory strength.

I71

RECOGNIZING WORDS IS NOT THE SAME AS RECOGNIZING PICTURES: INVESTIGATING THE MATERIAL SPECIFICITY OF ERP CORRELATES OF EPISODIC MEMORY IN A LARGE SAMPLE.

Catherine A. MacLeod[1], David I. Donaldson[2]; [1]Bangor University, [2]University of Stirling — Dual-process models of episodic memory propose that two independent retrieval processes support recognition memory – familiarity and recollection. Event-Related Potential (ERP) studies of recognition memory have identified a set of old/new effects, including putative correlates of familiarity (the 300-500ms mid-frontal effect) and recollection (the 500-800ms left-parietal effect). These ERP effects have been repeatedly demonstrated for word stimuli and provide one of the strongest sources of support for the dual process view of episodic memory. By contrast, however, recent evidence from studies using pictures of objects and faces suggest that the traditional old/new effects typically associated with episodic recognition may not provide a universal index of recollection and familiarity, with these stimuli showing a more anteriorally distributed effect compared to words. Here we present ERP memory effects for simple old/new recognition of words and pictures – using photographs that are rich in both conceptual and perceptual detail. ERP data was collected from a large sample of 122 participants, providing a large range of performance scores for each type of stimulus. The distribution of ERP old/new recognition memory effects was significantly different for words and pictures. During both early (300-500ms) and late (500-800ms) time windows the old/new effects were maximal over anterior locations for pictures, but maximal over posterior locations for words. These results therefore further support the hypothesis that the traditional mid-frontal and left-parietal old/new effects do not provide a universal index of recognition

memory, and that ERP correlates of episodic recognition are in fact material specific.

I72

INVESTIGATIONS OF EPISODIC ENCODING AND POST-ENCODING RESTING ACTIVITY USING INTRACRANIAL EEG Arielle Tambini[1], Thomas Thesen[2], Chad Carlson[2], Werner Doyle[2], Orrin Devinsky[2], Lila Davachi[1,3]; [1]Center for Neural Science, New York University, [2]Comprehensive Epilepsy Center, New York University School of Medicine, [3]Department of Psychology, New York University — Coordinated activity between cortical areas as well as between the hippocampus and cortex is thought to facilitate long-term memory storage in cortical networks. Much work in animals has provided evidence for increases in coordinated activity during post-encoding rest periods. In humans, we and others have recently shown that post-encoding hippocampal-cortical and cortico-cortical connectivity, as measured with fMRI, can be enhanced after associative learning experiences. In order to explore the neurophysiological basis of enhanced correlations during periods of post-encoding awake rest, we used a similar paradigm in epilepsy patients implanted with intracranial EEG electrodes. First, subjects performed a baseline rest block, followed by an object-face associative encoding task, followed by another rest block. We then tested subjects' item recognition as well as associative memory for stimuli seen during encoding. Subjects additionally performed a 1-back task on images of faces, objects, and other stimuli in order to isolate electrodes with stimulus-selective responses. Preliminary results show evidence for electrodes with stimulus selective responses using both event-related averaging and frequency-domain measures. These and other electrodes also show modulation of trial-evoked activity during encoding. Ongoing analyses are examining changes in activity patterns from baseline to post-encoding rest periods. These results will provide an important contribution to our understanding of processes occurring during post-encoding awake rest periods and their potential relevance for memory consolidation.

I73

REACTIVATION OF STIMULUS-SPECIFIC PROCESSING REGIONS IN AN ASSOCIATIVE MEMORY TASK Brion Woroch[1], Alex Konkel[2], Brian Gonsalves[1]; [1]University of Illinois, Urbana-Champaign, [2]Washington University in St. Louis — Theories of episodic memory often posit that retrieval involves reactivation of cortical regions engaged during initial processing of the episode. The current study investigates the idea that reactivation of these regions during episodic memory retrieval drives the experience of recollection of contextual detail, with the degree of reactivation determining the subjective strength of recollection. Specifically, we investigated whether stimulus-specific regions would reactivate during an associative memory task and whether the level of reactivation would scale with confidence in memory for encoded associations. At study, words were presented with either a picture of a face or a picture of a place/scene. We then identified face (fusiform face area; FFA) and place (parahippocampal place area; PPA) processing regions with localizer scans. At test, participants were presented with the words and asked to remember whether they had been previously presented with a face or a place, and to rate their confidence in this judgment on a 6-point scale. Consistent with predictions, results revealed a region in the left FFA that was more active during memory for words previously paired with a face than those shown with a scene. Conversely, a region in the left PPA was more active for words previously paired with places than faces. Results show that memory for associated source or contextual information involves reactivation of cortical regions that represent that type of information.

I74

SLEEPSOUNDS PROVIDE EVIDENCE FOR ACTIVE MEMORY CONSOLIDATION DURING SLEEP Jessica Creery[1], James W. Antony[1], Joel L. Voss[1,2], Ken A. Paller[1]; [1]Northwestern University, [2]University of Illinois at Urbana-Champaign — "SleepSounds" is a term to refer to the use of auditory stimulation during sleep to promote rehearsal and improve memory storage. In a prior study (Rudoy et al., 2009), we showed that cued recall of object-location associations could be improved via SleepSounds. After learning, object-related sounds were presented at low intensity during slow-wave sleep. Here we provided further evidence on the efficacy of SleepSounds. We hypothesized that SleepSounds might improve memory both as a reminder of the learning context and as a reminder of specific item locations. Prior to an afternoon nap, participants learned 50 object-location associations. Each object was always presented with a related sound. During the 2-hr retention interval, different groups of participants were either sleeping (S), sleeping with 25 cues (SC), waking (W), or waking with 25 cues (WC). In waking conditions, participants performed a demanding visual working-memory task. Memory, quantified by recall change scores, was superior in the two sleep groups compared to the two waking groups. When cues were administered during sleep, memory was superior for cued compared to uncued locations, but only for trials wherein recall before the nap was neither extremely accurate nor extremely poor. There was no evidence for memory effects due to cue administration during waking. Results failed to support the notion that cues served as general reminders of the learning context, but the specific memory advantage for cued versus uncued items confirmed the hypothesis of an active role of sleep in memory consolidation for specific item-location associations.

I75

AN INVESTIGATION OF EYE-MOVEMENT FIXATION PATTERNS TO REPEATED AND NOVEL FACES IN INDIVIDUALS WITH DEVELOPMENTAL PROSOPAGNOSIA Rosanna Olsen[1], Yunjo Lee[1], Jana Kube[1], Courtney Smith[1], Cheryl Grady[1,2,3], Morris Moscovitch[1,2], Jennifer Ryan[1,2,3]; [1]Rotman Research Institute, Baycrest, [2]Department of Psychology, University of Toronto, [3]Department of Psychiatry, University of Toronto — Face viewing is abnormal in developmental prosopagnosia (DP); however, little data exist addressing the question of whether individuals with DP demonstrate eye-movement based memory effects. We investigated whether a group of seven individuals with DP showed an intact face repetition effect, which is characterized by fewer fixations to familiar faces compared to novel ones. We further investigated whether small changes in viewpoint between repetitions (5-25° rotational shifts) affected the typical viewing decrease and whether these changes affected subsequent recognition. DPs and healthy controls made gender judgments on faces, each of which was seen five times over the course of the experiment in either the same viewpoint across repetitions (static condition) or different viewpoints across repetitions (alternating condition). Both groups made fewer fixations to repeated faces compared to novel faces; however, individuals with DP made significantly fewer fixations to the eyes and more fixations to the mouth compared to controls. Controls (but not individuals with DP) made more fixations to faces in the alternating condition compared to static condition. In both groups, subsequent recognition was significantly higher for faces probed with a repeated viewpoint compared to faces probed with a novel viewpoint; furthermore, this effect interacted with the study condition. Thus, although overt face recognition is impaired in DP and eye movements to faces differ between DP and controls, covert learning of faces in DP is relatively preserved. In addition, exposure to multiple views of a face facilitated subsequent recognition of a novel view in both groups.

I76

CLOSE RELATIONSHIPS IN AMNESIC PATIENTS Patrick Davidson[1], Heloise Drouin[1], Donna Kwan[2], Morris Moscovitch[3,4], Shayna Rosenbaum[2,3];

[1]University of Ottawa, [2]York University, [3]Rotman Research Institute, Baycrest, [4]University of Toronto — Recently, attention has turned to domains beyond memory in which amnesic patients may be impaired. We explored close interpersonal relationships in these patients. Do they retain pre-morbid relationships? Can they build new ones post-morbidly? Although Duff and colleagues (2009) recently reported an amnesic patient who established several new close interpersonal relationships, this report was at odds with our anecdotal observations of several other amnesic people. To examine close friendships in amnesia in a more systematic way, we administered the National Social life, Health, and Aging Project questionnaire to 3 amnesic patients (K.C., D.A., and H.C.) and controls, and to patients' family members for corroboration. The patients had somewhat fewer close relationships than the controls did. Notably, a higher-than-normal percentage of amnesic patients' close relationships were with family members. This may have been due to the patients' relative lack of involvement with neighbors and religious and community groups. The adult-onset cases (K.C. and D.A.) made few new close friends in the 2-3 decades since the onset of their amnesia. On the other hand, the patient with developmental amnesia (H.C.) had forged a few close relationships, including one with her fiancee. Social networks appear to be winnowed down by amnesia. The close relationships that remain in amnesic patients are more likely to be familial, in which the bonds are supported by social norms (e.g., marriage vows) and kinship. The obvious explanation for the patients' reduced social functioning stems from their memory impairment, but other impaired cognitive abilities may be crucial too.

I77

MOVING BEYOND ONE-PARAMETER DESCRIPTIONS OF RECOLLECTION. Iain M. Harlow[1], David I. Donaldson[2]; [1]UC Davis, [2]University of Stirling — Understanding of episodic memory has been enhanced by the analysis of Receiver-Operator Characteristic (ROC) curves, which provide more information about underlying memory than simple old/new decisions do. Inherently, however, the interpretation of ROC data requires reference to a theoretical model. Currently, the Dual-Process Signal Detection (DPSD) model is dominant, not least because it allows recollection and familiarity to be separately measured. The DPSD model relies, however, on the assumption that recollection always yields accurate, high confidence responses. Since this assumption has been widely challenged by recent studies, we advocate the use of a Variable-Recollection Dual Process (VRDP) model. The VRDP model is almost identical to DPSD, but differs in that it explicitly allows for variable recollection strength. Here we examine behavioral and neural data recorded during associative recognition tests. We demonstrate that the VRDP model provides a superior fit to behavioral data than DPSD, and, importantly, leads to dramatically different conclusions from the same dataset: the DPSD model suggests associative recognition is supported strongly by familiarity, whereas the VRDP model suggests familiarity does not meaningfully contribute. The VRDP interpretation is supported by Event-Related Potentials (ERPs) that reveal evidence of a mid-frontal (familiarity-linked) old/new effect for item, but not associative, recognition. The data also highlight a broader problem with the DPSD model - severe underestimation of variable recollection and overestimation of familiarity. As the field moves beyond one-parameter descriptions of recollection, the VRDP model offers a more robust way of correctly estimating the contribution of different processes to memory.

I79

USING SIGNAL DETECTION PARAMETERS TO INVESTIGATE THE RELATIONSHIP BETWEEN RECOGNITION AND CUED RECALL Andrew McCullough[1], Andrew P. Yonelinas[1], Jeffrey P. Toth[2]; [1]University of California Davis, [2]University of North Carolina Wilmington — A long-standing problem in research on explicit memory is finding ways to directly compare performance across different memory tests. Using a unique paradigm, we tested participants' memory with two common tests: recognition and cued recall. After studying a word list, participants were given a memory test that included both recognition and cued recall trials, and participants provided confidence ratings or subjective judgments (i.e., recollect, familiar) for each test item. While performance on these two explicit memory tests can be dissociated as a function of experimental variables, it is generally accepted that recognition and recall performance are correlated. Using signal detection parameters derived from the confidence ratings, we compared performance on the two tests within-participants. In agreement with prior research, performance was better on the recognition test, compared to cued recall. We show that the source of the discrepancy is similar across participants. Using process estimates derived from ROC curves, we further explore the relationship between the processes that support recognition and those that support cued recall. Neuroimaging studies have shown distinct neural substrates for the separate processes underlying recognition memory. The relationships shown between recognition and recall could facilitate future investigations of the neural correlates of the processes underlying these two memory tests.

I80

FAMILIARITY-BASED RESPONSES TO DIFFERENT VISUAL STIMULUS CATEGORIES IN THE MEDIAL TEMPORAL LOBE Chris Martin[1], Edward O'Neil[1], Victoria Barkley[1], Stefan K?hler[1]; [1]University of Western Ontario — The prevailing view in the current medial temporal lobe (MTL) literature is that item familiarity, i.e., the ability to recognize prior occurrence of a stimulus without retrieval of contextual associations about a specific encounter, is supported by perirhinal cortex (PRc). Currently, it remains unclear whether PRc mediates familiarity assessment for all stimulus categories or whether more posterior regions (i.e., parahippocampal cortex) are recruited for large scale stimuli, such as buildings. Although a number of fMRI studies have compared recognition for scenes and objects, results are difficult to interpret because such comparisons confound category specificity with relational processing demands; such demands are higher for scenes given they typically include multiple objects. In the perceptual literature, occipito-temporal regions have been shown to respond differentially to buildings, faces, and small scale objects such as chairs during visual discrimination. Here, we asked whether similar category specific effects would be present for familiarity-based item recognition decisions in the MTL. To address this question we conducted an fMRI study in which participants first studied photographs of buildings, faces, and chairs. During scanning at test, they were encouraged to base their recognition decisions on familiarity using a four point scale. Spontaneously occurring contextually-based recognition responses (i.e., recollective responses) were rare and discarded from our analyses. Behaviorally, recognition accuracy was matched across category types. We replicated previously reported category specific effects in posterior occipito-temporal regions. Importantly, our initial analyses also revealed category specific effects related to familiarity assessment in MTL regions, with a differential involvement beyond PRc.

I82

GESTURES MAKE MEMORIES, BUT WHAT KIND? THE COGNITIVE AND NEURAL MECHANISMS UNDERLYING HAND GESTURE Nathaniel Klooster[1], Susan Wagner Cook[1], David Warren[1], Melissa Duff[1]; [1]University of Iowa — Gestures influence communication, helping in the transmission of ideas from speakers to listeners. Gesturing also helps people learn and remember new information, suggesting that gestures impact cognition beyond simply supporting expression of already-formed ideas. The cognitive and neural mechanisms that support gesture, however, are unknown. Information conveyed in gesture is often not included in speech, and gestures are actions suggesting that these mental representations may be non-declarative. The current study replicates work by Cook and Tannenhaus (2009) that showed that viewing hand gestures during an explanation affected the listeners' subsequent thoughts and actions. Four patients with bilateral hippocampal damage and severe declarative memory impairment and four healthy matched comparison participants watched videos of someone explaining how to solve the Tower of Hanoi (TOH). The speakers' hand gestures, but not their speech, reflected par-

ticular actions associated with moving disks across the board either on a computer (flat sideways gesture) or using real objects (large arching hand gesture). The amnesic participants then solved the TOH on a computer. Like healthy participants, the mouse trajectories of amnesic patients were related to the particular gestures they observed (i.e., after watching the speaker with the large arching hand gesture, amnesic participants' mouse trajectories displayed higher arching). Participants mentally represented the gesture and the representation affected their subsequent actions. Amnesic patients, who could not consciously recall the video explanations, formed a lasting impression that guided their behavior. These findings suggest that the comprehension and mental representation of gesture is independent of the hippocampal declarative memory system.

I83

IS WHAT GOES IN WHAT COMES OUT? ENCODING AND RETRIEVAL ERP COMPONENTS IN RECOGNITION MEMORY ARE RELATED Yvonne Chen[1], Kirstie Lithgow[1], Jumjury Hemmerich[2], Jeremy Caplan[1,2]; [1]Centre for Neuroscience, [2]Department of Psychology — The study of memory is about tracking an item from encoding to retrieval. Previous research has identified event-related potential (ERP) components at study ("subsequent memory effect," SME, comparing subsequent hits with misses) and at test ("old/new effect", comparing hits with correct rejections). The late positive component (LPC) of the SME and the FN400 old/new effect have each been linked to shallow processing (rote rehearsal and familiarity-based recognition). Similarly, the slow-wave SME and the late parietal positivity (LPP) old/new effect have each been linked to deep processing (semantic study and recollection-based recognition). We tested the hypothesis that the variability in encoding tapped by the LPC-SME materializes as variability in the FN400 and likewise for the slow-wave-SME and LPP. We correlated difference measures for SME components with both old/new effect and retrieval success (RS; hits vs. misses) components across 64 participants. In line with our predictions, significant ($p<0.05$) correlations were found between the LPC and the FN400 (RS) [$r(63) = 0.35$], and between the slow wave and the LPP (old/new) [$r(63) = 0.26$]. Partial correlations suggested that these correlations mediated two additional correlations. Unexpectedly, the slow-wave-LPP association was non-significant when using retrieval success, consistent with recent suggestions that the parietal contribution to recognition may not be necessary for accurate recognition. Our findings largely confirm the emerging interpretation of these four commonly reported memory ERPs, but suggest that this kind of large-sample, individual-difference approach could be extended to sharpen our understanding of the broader range of memory ERPs.

I84

SWITCHING FROM THE PARIETAL-EPISODIC TO THE STRIATUM-BASED MEMORY SYSTEM AFTER INCREASING CENTRAL CHOLINERGIC ACTIVITY DURING CONSOLIDATION Monika Schoenauer[1], Luca Matarazzo[2], Mélanie Boly[2], Audrey Vanhaudenhuyse[2], Thien Thanh Dang-Vu[2], Annabelle Darsaud[2], Pierre Maquet[2], Steffen Gais[1]; [1]LMU Munich, [2]Université de Liège — Memory function and its behavioral effects are the result of parallel processing of experience in multiple interacting neural systems. Depending on the task and environmental conditions, individual systems contribute various amounts to memory formation. Acetylcholine modulates this relative contribution of different systems to memory formation. Low levels of acetylcholine are thought to facilitate the consolidation of hippocampus-dependent declarative memory. On the other hand, the caudate nucleus can inhibit hippocampal processing via cholinergic mechanisms. Here, we investigated how memory consolidation is modified by increasing central cholinergic activity in both sleep and wakefulness. Subjects learned a paired-associate wordlist task. During the consolidation interval, the cholinesterase inhibitor physostigmine was administered. Afterwards, during recall testing, brain activity was measured with fMRI. Recall in the placebo condition activated mainly the precuneus ($pFWE<.05$), whereas recall after physostigmine infusion recruited primarily the caudate nucleus ($pFWE<.05$). The precuneus is frequently ascribed an episodic retrieval function in the declarative memory system, whereas the caudate nucleus of the striatum is usually associated with the consolidation of stimulus-response-learning. We suggest that cholinergic modulation suppressed hippocampal-neocortical memory consolidation, while at the same time strengthening consolidation in the striatal memory system. Together, our results further strengthen the idea of cholinergic influences on memory consolidation, and demonstrate the possibility of a flexible interaction between different memory systems.

I85

THE POSTERIOR PARIETAL CORTEX FACILITATES INTERACTION WITH MEMORIES FROM A FIRST-PERSON PERSPECTIVE Jeremy Elman[1], Alice Verstaen[1], Arthur P Shimamura[1]; [1]University of California, Berkeley — In neuroimaging studies, the posterior parietal cortex (PPC) has been found to show greater activation for successful retrieval of studied items compared to new items. In particular, the angular gyrus is especially active for high confidence recollection responses. However, the boundary conditions under which this region is active remains unclear. A common approach to developing models of PPC function in memory has been to draw on research from other areas of research in which the parietal cortex has long been implicated, such as attention and spatial cognition. One model by Byrne, Becker, & Burgess (2007) proposes that memories created from a first-person, egocentric framework are transformed into a viewpoint independent, allocentric framework for long-term storage in the medial temporal lobes. When retrieving this flexible form of memory, a reverse translation integrates current position and heading to facilitate mental exploration of the retrieved memory. Here, we assess activation in the PPC (angular gyrus in particular) based on whether a task requires memory for an environment to be translated to an egocentric representation or not. Subjects were asked to make judgments from memory regarding either the direction of buildings in comparison to a given location and heading, or distance of a building from a given street. Results showed greater activation in the angular gyrus for the direction task. This suggests a role for the angular gyrus in translating stored representations into an egocentric framework which may underlie our ability to re-experience and interact with memories from a first-person perspective.

I86

PARIETAL ACTIVITY IS INDICATIVE OF CONTEXTUAL BINDING IN EPISODIC RETRIEVAL ZACHARY ROSNER[1], Jeremy Elman[1], Brendan Cohn-Sheehy[1], Arthur Shimamura[1]; [1]University of California, Berkeley — Prior functional magnetic resonance imaging (fMRI) studies have demonstrated that the posterior parietal cortex (PPC) signals successful episodic retrieval (hits>correct rejections), though its particular role in memory remains unclear. The Cortical Binding of Relational Activity (CoBRA) model posits that the inferior PPC acts to bind object and contextual information (Shimamura, 2011). Therefore, heightened activity in the inferior PPC is expected when contextual information is particularly important to retrieval. Via fMRI, we examined retrieval-related PPC activity for images. During encoding, participants from UC Berkeley viewed novel buildings from campuses other than UC Berkeley. At retrieval, participants were scanned while viewing either buildings seen during the encoding phase, familiar (i.e., located on the UC Berkeley campus), or unfamiliar buildings. Subjects responded whether they recognized each with confidence ratings. Heightened bilateral angular gyrus activity was observed for previously studied buildings compared to buildings that were simply familiar. Although familiar buildings elicited increased lateral occipital cortex activity compared to new buildings, these context-independent items did not lead to increased activation in the angular gyrus. These results support the CoBRA model, suggesting that retrieval related PPC activity is particularly sensitive to contextual binding of information and not merely retrieval success.

I87

NEURAL CORRELATES OF REACTIVATION AND RETRIEVAL-INDUCED DISTORTION Donna J Bridge[1], Ken AN Paller[1]; [1]Northwestern University — Reactivation -- neural replay of prior events -- occurs spontaneously during sleep and wake, and is thought to facilitate memory consolidation. Reactivation may be exogenously induced through sensory stimulation. Of course, certain stimuli will function as reminder cues and thereby induce retrieval. Retrieval may function (a) to reinforce the information initially stored, or (b) to promote storage of the retrieval event, which can alter the original representation, sometimes reducing accuracy. Here, we sought to identify neural signals of memory consolidation and examine the influence of retrieval on memory storage. Participants learned novel object-location associations in a 3-session protocol. At Session 1, participants learned 180 associations and then completed a cued-retrieval test; at Session 2, EEG was recorded while a subset of the associations were reactivated via cued retrieval; and at Session 3, a final cued-retrieval test was administered. We found that cued reactivation strengthened long-term memory and facilitated storage of the reactivation event, presumably due to retrieval practice. For cues that produced a relatively stronger memory for the original location, a late positivity between 400-600 ms reflected this successful retrieval. Although subsequent memory effects for the original representation were not apparent, there were reliable subsequent memory effects (at 600-1000 ms) that predicted memory for the reactivation location. Reactivation thus appeared to produce distortion based on less-than-perfect retrieval following the reactivation cue. This evidence demonstrates an integration of retrieved information with information stored earlier, leading to retrieval-induced memory distortion.

I88

PERCEPTUAL REACTIVATION DURING COVERT RECALL PREDICTS LATER MEMORY ACCURACY Erik Wing[1], Maureen Ritchey[2], Roberto Cabeza[1]; [1]Duke University, [2]University of California, Davis — Remembering items produces neural activity comprising both general retrieval processes and elements specific to the initial encoding episode. This reactivation may reflect perceptual features of a specific stimulus, encoding context, or evaluative processes that were present during encoding. Recent work focusing on reinstatement of encoding judgments has also shown that the patterns of reactivation vary by the confidence with which items are remembered during recognition (Johnson et al. 2009). To explore the relationship between reactivation, subjective experience, and memory accuracy, we used an fMRI paradigm designed to elicit specific cortical reactivation during covert cued recall. During encoding, participants viewed a series of detailed scene images along with descriptive labels of each image (e.g. "mountain range"). The labels were then presented alone during a retrieval session in which participants rated the vividness with which they could recall the associated picture. A post-scan exemplar recognition task (with highly similar exemplars) displayed a direct correspondence to vividness ratings, with higher recognition performance at each increasing level of vividness. Retrieval was associated with widespread activity in occipital cortex and parahippocampal gyrus—demonstrating reactivation of areas highly engaged in perceptual encoding—along with phase-specific activity in posterior midline and dorsal parietal regions. In parametric analyses, retrieval activity in medial prefrontal, bilateral hippocampal, and parahippocampal regions increased with vividness ratings. These findings suggest hippocampally-linked recovery of perceptual information corresponding to reported vividness and memory accuracy.

I89

SPATIAL CLUSTERING DURING MEMORY SEARCH Jonathan Miller[1], Markus Neufang[2], Joshua Jacobs[1], Michael J Kahana[3]; [1]Drexel University, [2]University of Freiburg, [3]University of Pennsylvania — An important issue in understanding the nature of human memory is learning how people remember where and when events occurred. We investigated this by examining performance in a unique memory task containing both episodic and spatial memory components. In our experiments, participants were asked to navigate a virtual town with the goal of delivering objects to various distinct landmarks. After a series of deliveries, participants were asked to recall the identities of the delivered items. We found that location had a strong organizational effect on the order of participants' recall sequences, such that items that were recalled nearby in time were likely to have been previously delivered to nearby landmarks in the town. Moreover, we analyzed electrophysiological brain data recorded during the task, revealing that patterns of neural activity representing spatial information during navigation were reinstated when the delivery items were recalled. Together, these findings suggest that that there is a close link between the neural circuits that support human episodic and spatial memory.

METHODS: Other

I90

SIMULTANEOUSLY RECORDED EEG AND FMRI IDENTIFIES BRAIN NETWORKS RELATED TO VISUALLY-EVOKED GAMMA OSCILLATORY ACTIVITY Erika Nyhus[1], Michael S. Worden[1], David Badre[1]; [1]Brown University — A growing literature has highlighted the importance of neural oscillations in cognition. These rhythms may reflect neural synchonization both within and between brain regions during task performance. However, EEG cannot localize the network of brain regions that correlate with changes in oscillatory activity. Simultaneously recording EEG and fMRI may provide a means to identify brain networks correlated with trial-by-trial fluctuations in oscillatory activity. However, relatively few studies have related oscillatory effects in EEG to simultaneously measured changes in the BOLD signal. The present study sought to validate this approach by simultaneously recording EEG and fMRI during an established visual target detection paradigm. Subjects were shown a checkerboard that was presented to the right or the left visual field and were asked to detect a missing square that occurred on 10% of the trials. EEG was recorded with a 64-channel MRI compatible system. EEG analysis was performed on the channel data after MR gradient and cardioballistic artifacts were removed. EEG was correlated to the fMRI BOLD activity by entering single-trial gamma power as a regressor in the fMRI analysis. Consistent with prior work, there were posterior P1 ERP effects. Importantly, preliminary results showed that posterior gamma power correlated with the fMRI BOLD response in inferior occipital cortex. These results suggest that correlating EEG oscillatory activity to the BOLD signal can reveal functional networks related to oscillatory effects. Simultaneous EEG and fMRI methods for correlating oscillatory activity to the fMRI BOLD response in various cognitive domains will be discussed.

PERCEPTION & ACTION: Vision

I91

DECODING VISUAL SELF-BODY REPRESENTATION IN THE HUMAN BRAIN Barbara Vogt[1], Simone Schütz-Bosbach[1], Carsten Bogler[2], John-Dylan Haynes[2,3]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Bernstein Center for Computational Neuroscience, Berlin, Germany, [3]Berlin Center for Advanced Neuroimaging (BCAN), Berlin, Germany — The present study sought to investigate the visual representation of one's own and others' bodies using fMRI and multivariate pattern classification, employing a novel approach. While previous research mainly focused on locating differential sensitivity for self and others using activation differences, we aimed to study whether the representation of the own body differs from that of other bodies in the sense of more information being encoded. Participants were shown static images of their own body as well as those of a familiar- and unfamiliar other, respectively, from three different visual perspectives, while being engaged in a luminance change detection task. Results showed that different perspectives were decodable significantly better for visual self-body stimuli compared to familiar and unfamiliar bodies in left hip-

pocampus, fusiform gyrus, bilateral posterior cingulum and precuneus. Visual perspectives of familiar other body stimuli could selectively be decoded better than all other bodies from activity in left middle frontal gyrus. For decoding unfamiliar bodies no specific brain locations could be identified. These results indicate that one's own body is indeed represented in a unique fashion, even when directly compared with familiar others and even when no conscious body recognition is required. Areas identified for representing the visual self-body have, for example, been associated with configural body processing, memory, and self-referential processing. The frontal region specifically involved in representing familiar other bodies may be part of a broader network for body identification.

I92

MICROSACCADE DIRECTION AND SPONTANEOUS ATTENTION SHIFTS Shlomit Yuval-Greenberg[1], Elisha P. Merriam[1], David J. Heeger[1]; [1]NYU, department of Psychology and Center for Neural Science — Purpose: In a cued-attention "Posner" protocol, microsaccade direction tends to follow the cue. This observation has led to the hypothesis that microsaccades index the locus of attention. We tested this hypothesis by determining whether microsaccade direction is also affected by spontaneous shifts of attention without a cue. Methods: Subjects fixated a cross while microsaccades were detected from the streaming eye position data. On half of the trials, detection of a microsaccade triggered the appearance of eight peripheral grating patches at one of three eccentricities (microsaccade condition). On remaining trials, identical stimuli appeared but were not triggered by a microsaccade (no-microsaccade condition). In both conditions, the grating patches were followed by a central arrow indicating the target location. In the microsaccade condition, the arrow was either congruent or incongruent (opposite) with respect to the microsaccade trajectory. In the no-microsaccade condition, the arrow pointed randomly toward one of the gratings. The task was to report the tilt direction of the target grating. Results: Accuracy rates were higher for "congruent" than for "incongruent" trials, especially in the middle eccentricity. The spatial distribution of performance accuracy was correlated with the spatial distribution of microsaccade frequency. Conclusion: the direction of microsaccades occurring during fixation (with no cue) is linked to spontaneous fluctuations in the locus of attention.

I93

CONDITIONAL PROBABILITY EFFECTS IN VISUAL SEARCH Bryan Cort[1], Britt Anderson[1,2]; [1]University of Waterloo, Waterloo, ON, Canada, [2]Centre for Theoretical Neuroscience, University of Waterloo, Waterloo, ON, Canada — The goal of our study was to investigate the effects of probability on visual search in general and the efficiency of visual search in particular. Previous work has shown that people can utilize both spatial and sequential probability information to improve their performance on simple visual attention tasks. In our study, participants searched a field of distractors (cyan and magenta diamonds) for a target (a cyan or magenta diamond with one corner removed) and reported which corner (top, left, right, or bottom) was missing. At the beginning of each trial, participants saw two cues (each colored magenta or cyan, independently of the other), which indicated the probable color of the target. The absolute probability of a particular color target on any given trial was 0.5; however, the conditional probability – the likelihood of a particular color given a particular cue combination – varied from 0.1 to 0.9. For example, on 90% of trials in which both cues were magenta, the target was magenta. Accuracy was high (mean = 98.7%) and response time increased linearly as a function of number of distractors on screen. Participants were faster to locate and report high conditional probability targets and slower to locate and report low conditional probability targets. In addition, the efficiency of search (indexed by the response time/distractor number slope) increased for the high conditional probability cases and decreased for the low conditional probability cases. We conclude that participants utilize knowledge of conditional probability to increase the efficiency of visual search.

I94

ADAPTATION TO LEFTWARD-SHIFTING PRISMS ALTERS CONFIGURAL FACE PROCESSING: EVIDENCE FROM THE COMPOSITE FACE ILLUSION AND FMRI Janet Bultitude[1,2], John Taylor[3], Jo Mason[4], Robert Rafal[4], Paul Downing[4]; [1]University of Oxford, [2]INSERM, Lyon, France, [3]Cardiff University, [4]Bangor University — When the upper and lower halves of two faces are recombined, the result is a virtually unavoidable illusion that one is viewing the face of a third, different person (the 'composite face illusion'). When asked to identify the top or bottom halves of such composites there is a reaction time (RT) cost compared to when performing the same task when the two face halves are offset. Such observations demonstrate our automatic configural or global-level processing of faces. Recent research from our lab demonstrates that visuo-motor adaptation to leftward, but not rightward, prismatic shifts in the visual field decreased processing of global relative to local levels of hierarchical Navon figures by healthy individuals. Here we demonstrate that prism adaptation also eliminates configural face processing. Participants (N=64) identified the top or bottom halves of composite faces constructed from photographs of Brad Pitt and George Clooney. Before prism adaptation, both groups showed RT costs for aligned composites compared to misaligned composites in which the face-halves were offset, preventing configural processing. This RT cost was eliminated in participants who adapted to leftward-shifting prisms, however adaptation to rightward-shifting prisms did not change performance. In a second study (N=17) examining BOLD signal changes associated with this effect, adaptation to leftward-shifting prisms resulted in elevated activity in the right fusiform face area for aligned compared to misaligned composites. These results add to a growing literature suggesting that low-level sensory-motor realignment by prism adaptation can have a pervasive influence on higher cognitive functions.

I95

COSTS OF SWITCHING SCENE CATEGORY IN REAL-WORLD SEARCH Kevin Price[1], Satoru Suzuki[1], Marcia Grabowecky[1]; [1]Northwestern University — Real-world visual search is heavily dependent on context, and experienced searchers use their knowledge of scenes to facilitate search. While it is known that searching in the exact same scene facilitates search, is it possible to produce similar effects by repeating different scenes from the same category? Furthermore, will these effects hold for different exemplars of a target? If so, we would predict that (1) Repeated search within real-world scenes from similar categories will facilitate visual search, and (2) A sudden switch to a different real-world scene type will cause a drop in search efficiency. To test these hypotheses, we had participants search for birds in three blocks of different scene categories: urban, forest, and indoor. Switching scenes exacted a significant cost in search efficiency, particularly as learning grew stronger. This search cost remained when the scenes were uniformly inverted during presentation, and when targets and scenes were randomly inverted throughout the task, suggesting that this effect is not due to long-term familiarity with global scene features. Furthermore, an analysis of the effect of target location showed a severe decrease in search efficiency when the target bird was located in the bottom quarter of the display, consistent with previous studies that suggest that the nature of real-world targets influence expectations of probable target locations.

I96

THE ATTRACTIVENESS OF FACIAL AVERAGENESS: A COMPARISON OF ADULTS AND CHILDREN Larissa Vingilis-Jaremko[1], Daphne Maurer[1], David Feinberg[1]; [1]McMaster University — Adults rate averaged faces with feature shapes, sizes, and locations approximating the population mean as more attractive than most individual faces (e.g., Langlois & Rogmann, 1990). We are examining developmental changes in the influence of averageness by showing adults and children pairs of individual faces, in which one face was transformed 50% toward its group average, while the other face was transformed 50% away from that average. In Experiment 1, adults and 5-year-olds (n = 36/group) rated the more average faces as

more attractive whether the faces were of adult females, 5-year-old boys, or 5-year-old girls (all ps < .001). The effect of averageness, however, was significantly weaker in 5-year-olds than in adults (main effect of age, p < .001). In Experiment 2, adults and 9-year-olds (n=26/group) rated the more average faces as more attractive for male and female faces of adults, 9-year-olds, and 5-year-olds (all ps < .001). However, the influence of averageness was again weaker for children than for adults (main effect of age, p =.006). The results indicate that the influence of averageness increases between children age 5-9 and adulthood. The changes may reflect the refinement of an average face prototype as the child is exposed to more faces, increased sensitivity to distinctive cues in the faces experienced, and/or the greater salience of attractiveness after puberty. To evaluate the influence of experience, results will be compared to those from ongoing tests of children in single-gender versus mixed-gender schools.

I97

TIME-DILATION AFTEREFFECT MEDIATED BY LOW-LEVEL VISUAL PROCESSING Laura Ortega[1], Emmanuel Guzman-Martinez[1], Marcia Grabowecky[1], Satoru Suzuki[1]; [1]Northwestern University — Several seconds of adaptation to a flickered stimulus makes a subsequently presented brief (200-800ms) static stimulus appear longer in duration. We investigated what causes this time-dilation aftereffect by manipulating the adaptor and test stimuli and measuring the perceived duration of the test stimulus using a standard temporal-bisection task. The time-dilation aftereffect is significantly reduced by a 45° change in Gabor orientation between adaptation and test. The reduction of the aftereffect with a small 45° orientation change suggests the involvement of lower-level cortical visual neurons (orientation-tuning bandwidths are approximately 25–40° in V1, 35–75° in V4, and 70° in Inferotemporal cortex). Furthermore, the time-dilation aftereffect is abolished when the adaptor and test stimuli are presented to different eyes. Because eye preferences are strong in V1 but diminish in high-level visual areas, the specificity for eye of origin corroborates the involvement of low-level visual neurons. This also suggests that cognitive processing does not contribute to the aftereffect because people are unaware of eye-of-origin information. Finally, the time-dilation aftereffect occurs for a broad range of flicker rates (no difference between 5Hz and 20Hz adaptation). These results suggest that flicker adaptation of low-level cortical visual neurons contributes to expanding the perceived duration of subsequently presented stimuli. This time-dilation aftereffect dissociates from the previously reported time-constriction aftereffect, which is orientation independent and frequency dependent (an aftereffect with 20Hz but no aftereffect with 5Hz). Thus, the visual system may possess two complementary types of timers to adaptively adjust temporal processing across the visual field.

I98

ELECTRICAL BRAIN DYNAMIC OF PROBABILISTIC INTENTION PREDICTION IN DYADS Elizabeth Clark-Polner[1], Nisa Patel[2], Stephanie Ortigue[1,2]; [1]University of Geneva, Switzerland, [2]Syracuse University — Recent evidence suggests that intention perception may be facilitated by the emotional bond between actor and perceiver (stronger bond = faster intention understanding). In line with embodied cognition theory, we posit that this facilitation may be due to differential learned situational probability (closer partners = greater familiarity = faster intention perception processing.) To address this question, we examined the spatio-temporal dynamics of brain activity from 23 volunteers during a standard behavioral intention inference task (in which individuals were asked to distinguish between neutral intentions of four types of agents (participant; participant's best friend; president of participant's sorority; same-sex stranger), portrayed in a three-frame videos; see: Ortigue et al., 2009), using high-density 128-channel electroencephalogram recordings. Analysis of group-averaged visual-evoked potentials identified four stable brain microstates; GLM repeated measures analyses revealed a double dissociation in duration of two stable, distinct, brain-microstates within the first 250 ms post-stimulus, distinguishing perceptions of best friends' from sorority presidents' intentions. Perceptions of sorority presidents' intentions were characterized by significantly greater duration of the earlier microstate (occurring up to 168ms post-stimulus; current source density maximum in the cuneus), and significantly lesser of the latter microstate (occurring up to 250ms post-stimulus; current source density in the right-uncus-area); perceptions of best friends' intentions evinced the exact opposite pattern (p < .05). In line with our hypothesis, the results implicate brain areas mediating perception of social hierarchy, associative memory, person knowledge, and learning in the early stages of intention perception.

I99

NONCONSCIOUS PRIMING ENHANCES THE PROCESSING OF DEGRADED STIMULI Eric S. Clapham[1], Aaron T. Karst[2]; [1]Black Hills State University, [2]University of Nevada, Reno — How does object information obtained during brief fixation influence the later processing of that stimuli under degraded conditions, processing that is dominated by the magnocellular pathway? This project explored how very brief exposures to full spectrum stimuli can facilitate the recognition of that object following high spatial frequency filtering. Each trial consisted of a stream of stimuli that began with a fixation point and terminated with a target stimuli that required a forced choice response. Prior to target presentation a forward and backward masked full spectrum prime was presented for 33 ms, a duration that proved quick enough to limit awareness. The task was to identify a filtered target stimulus and categorize it as natural or man made. Congruent conditions, trials that presented corresponding stimuli, resulted in significantly faster response times when compared to the incongruent conditions. These data indicate that the information that enters the visual system but does not originally attract a great deal of attention and awareness can still be utilized for more efficient processing later. The information obtained from the brief exposure to the prime may facilitate processing via top-down modulation from the magnocellular channels. This type of modulation may also help provide the illusion of a clear and detailed visual world, a perception that seems to extend beyond foveal vision.

I100

THE EFFECT OF TARGET/NON-TARGET SIMILARITY ON SPEED OF VISUAL OBJECT DISCRIMINATION Amy Guthormsen[1], Michael Ham[1], John George[1], Brenna Fearey[1], Luis Bettencourt[1]; [1]Los Alamos National Laboratory — Event related potentials have been used to demonstrate the fact that humans can discriminate natural images containing an animal from those that do not in less than 150 ms (Thorpe et al. 1996). These data have been used to argue that feedback from visual areas higher in the processing hierarchy to lower areas cannot be an important aspect of visual object recognition because 150 ms is not long enough to allow such feedback to occur. However, images that contain animals differ systematically in many ways from those that do not. In this study we asked individuals to identify a more specific class of targets (Experiment 1: cats or dogs, Experiment 2: male or female human faces). Non-target images included both those containing a non-target object highly similar to the target (e.g. target: cat, non-target: dog) and those without a similar non-target (Experiment 1: images with no animal present, Experiment 2: non-face objects). Our data show that although ERP waveforms for targets diverge from dissimilar non-target waveforms in less than 150 ms, they do not reliably diverge from waveforms produced in response to more similar non-targets until much later (c. 350 ms). These data are consistent with the theory that a first-pass feed-forward processing stream may account for discrimination of a fairly broad class of stimuli, such as animals, but making the fine level discrimination that is characteristic of basic level object identification requires enough time for recurrent pathways to operate.

Poster Topic Index

ATTENTION: Auditory
Posters A1 - A4, A6 - A10, Saturday, 5:30 - 7:30 pm
Posters C23, Sunday, 1:00 - 3:00 pm

ATTENTION: Development & aging
Posters B1 - B8, Sunday, 8:00 - 10:00 am

ATTENTION: Multisensory
Posters C1 - C7, Sunday, 1:00 - 3:00 pm

ATTENTION: Nonspatial
Posters D1 - D5, Sunday, 4:00 - 6:00 pm

ATTENTION: Other
Posters E1 - E10, Monday, 8:00 - 10:00 am
Posters F1 - F10, Monday, 1:00 - 3:00 pm

ATTENTION: Spatial
Posters F11 - F22, Monday, 1:00 - 3:00 pm
Posters G1 - G12, Monday, 5:00 - 7:00 pm

EMOTION & SOCIAL: Development & aging
Posters B9 - B21, Sunday, 8:00 - 10:00 am

EMOTION & SOCIAL: Emotion-cognition interactions
Posters C8 - C17, Sunday, 1:00 - 3:00 pm
Posters D6 - D15, Sunday, 4:00 - 6:00 pm
Posters E11 - E20, Monday, 8:00 - 10:00 am
Posters F23 - F32, Monday, 1:00 - 3:00 pm
Posters G13 - G22, Monday, 5:00 - 7:00 pm
Posters H1 - H10, Tuesday, 8:00 - 10:00 am
Posters I2 - I15, Tuesday, 3:00 - 5:00 pm

EMOTION & SOCIAL: Emotional responding
Posters A83, Saturday, 5:30 - 7:30 pm
Posters C18 - C19, Sunday, 1:00 - 3:00 pm
Posters C21 - C27, Sunday, 1:00 - 3:00 pm
Posters E21 - E29, Monday, 8:00 - 10:00 am
Posters F34 - F42, Monday, 1:00 - 3:00 pm

EMOTION & SOCIAL: Other
Posters C28 - C37, Sunday, 1:00 - 3:00 pm
Posters D16 - D22, Sunday, 4:00 - 6:00 pm

EMOTION & SOCIAL: Self perception
Posters A11 - A21, Saturday, 5:30 - 7:30 pm

EXECUTIVE PROCESSES: Development & aging
Posters B22 - B31, Sunday, 8:00 - 10:00 am
Posters C48 - C57, Sunday, 1:00 - 3:00 pm
Posters D24 - D32, Sunday, 4:00 - 6:00 pm

EXECUTIVE PROCESSES: Goal maintenance & switching
Posters A22 - A38, Saturday, 5:30 - 7:30 pm

EXECUTIVE PROCESSES: Monitoring & inhibitory control
Posters C58 - C67, Sunday, 1:00 - 3:00 pm
Posters H11 - H20, Tuesday, 8:00 - 10:00 am
Posters I29 - I39, Tuesday, 8:00 - 10:00 am

EXECUTIVE PROCESSES: Other
Posters C68 - C75, Sunday, 1:00 - 3:00 pm
Posters I40- I52, Tuesday, 8:00 - 10:00 am

EXECUTIVE PROCESSES: Working memory
Posters A5, Saturday, 5:30 - 7:30 pm
Posters C76 - C85, Sunday, 1:00 - 3:00 pm
Posters D33 - D42, Sunday, 4:00 - 6:00 pm
Posters F43 - F57, Monday, 1:00 - 3:00 pm
Posters G23 - G32, Monday, 5:00 - 7:00 pm

LANGUAGE: Development & aging
Posters B32 - B41, Sunday, 8:00 - 10:00 am
Posters C86 - C93, Sunday, 1:00 - 3:00 pm
Posters C95 - C96, Sunday, 1:00 - 3:00 pm

LANGUAGE: Lexicon
Posters D43 - D53, Sunday, 4:00 - 6:00 pm
Posters E30 - E40, Monday, 8:00 - 10:00 am

LANGUAGE: Other
Posters E41 - E50, Monday, 8:00 - 10:00 am
Posters F58 - F67, Monday, 1:00 - 3:00 pm
Posters G33 - G39, Monday, 5:00 - 7:00 pm
Posters I53 - I62, Tuesday, 3:00 - 5:00 pm

LANGUAGE: Semantic
Posters E51 - E60, Monday, 8:00 - 10:00 am
Posters F68 - F77, Monday, 1:00 - 3:00 pm
Posters G40 - G49, Monday, 5:00 - 7:00 pm
Posters H21 - H29, Tuesday, 8:00 - 10:00 am

LANGUAGE: Syntax
Posters A39 - A45, Saturday, 5:30 - 7:30 pm

LONG-TERM MEMORY: Development & aging
Posters B42 - B54, Sunday, 8:00 - 10:00 am
Posters C97 - C102, Sunday, 1:00 - 3:00 pm
Posters D54 - D57, Sunday, 4:00 - 6:00 pm

LONG-TERM MEMORY: Episodic
Posters A73, Saturday, 5:30 - 7:30 pm
Posters C20, Sunday, 1:00 - 3:00 pm
Posters D58 - D66, Sunday, 4:00 - 6:00 pm
Posters E61 - E70, Monday, 8:00 - 10:00 am
Posters F78 - F87, Monday, 1:00 - 3:00 pm
Posters G50 - G69, Monday, 5:00 - 7:00 pm
Posters H30 - H39, Tuesday, 8:00 - 10:00 am
Posters I63 - I89, Tuesday, 3:00 - 5:00 pm

LONG-TERM MEMORY: Other
Posters E71 - E77, Monday, 8:00 - 10:00 am
Posters H40 - H49, Tuesday, 8:00 - 10:00 am

LONG-TERM MEMORY: Priming
Posters A46 - A50, Saturday, 5:30 - 7:30 pm

LONG-TERM MEMORY: Semantic
Posters D68 - D80, Sunday, 4:00 - 6:00 pm

LONG-TERM MEMORY: Skill learning
Posters H50 - H63, Tuesday, 8:00 - 10:00 am

METHODS: Electrophysiology
Posters D81 - D84, Sunday, 4:00 - 6:00 pm

METHODS: Neuroimaging
Posters D85 - D92, Sunday, 4:00 - 6:00 pm
Posters E78 - E90, Monday, 8:00 - 10:00 am

METHODS: Other
Posters I90, Tuesday, 3:00 - 5:00 pm

MOTION & SOCIAL: Person perception
Posters C38 - C47, Sunday, 1:00 - 3:00 pm
Posters I16 - I28, Tuesday, 3:00 - 5:00 pm

NEUROANATOMY
Posters A51 - A58, Saturday, 5:30 - 7:30 pm

Other
Posters A59 - A63, Saturday, 5:30 - 7:30 pm

PERCEPTION & ACTION: Audition
Posters C94, Sunday, 1:00 - 3:00 pm
Posters F88 - F98, Monday, 1:00 - 3:00 pm
Posters G70 - G79, Monday, 5:00 - 7:00 pm

PERCEPTION & ACTION: Development & aging
Posters B55 - B61, Sunday, 8:00 - 10:00 am

PERCEPTION & ACTION: Motor control
Posters D93 - D102, Sunday, 4:00 - 6:00 pm
Posters E91 - E100, Monday, 8:00 - 10:00 am
Posters G80 - G86, Monday, 5:00 - 7:00 pm

PERCEPTION & ACTION: Multisensory
Posters H64 - H90, Tuesday, 8:00 - 10:00 am

PERCEPTION & ACTION: Other
Posters A64 - A72, Saturday, 5:30 - 7:30 pm
Posters A74 - A79, Saturday, 5:30 - 7:30 pm
Posters F33, Monday, 1:00 - 3:00 pm
Posters F73, Monday, 1:00 - 3:00 pm

PERCEPTION & ACTION: Vision
Posters G87 - G101, Monday, 5:00 - 7:00 pm
Posters H91 - H100, Tuesday, 8:00 - 10:00 am
Posters I91 - I100, Tuesday, 3:00 - 5:00 pm

THINKING: Decision making
Posters B62 - B73, Sunday, 8:00 - 10:00 am
Posters C103 - C112, Sunday, 1:00 - 3:00 pm
Posters D103 - D112, Sunday, 4:00 - 6:00 pm
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THINKING: Reasoning
Posters G102 - G109, Monday, 5:00 - 7:00 pm

Author Index

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

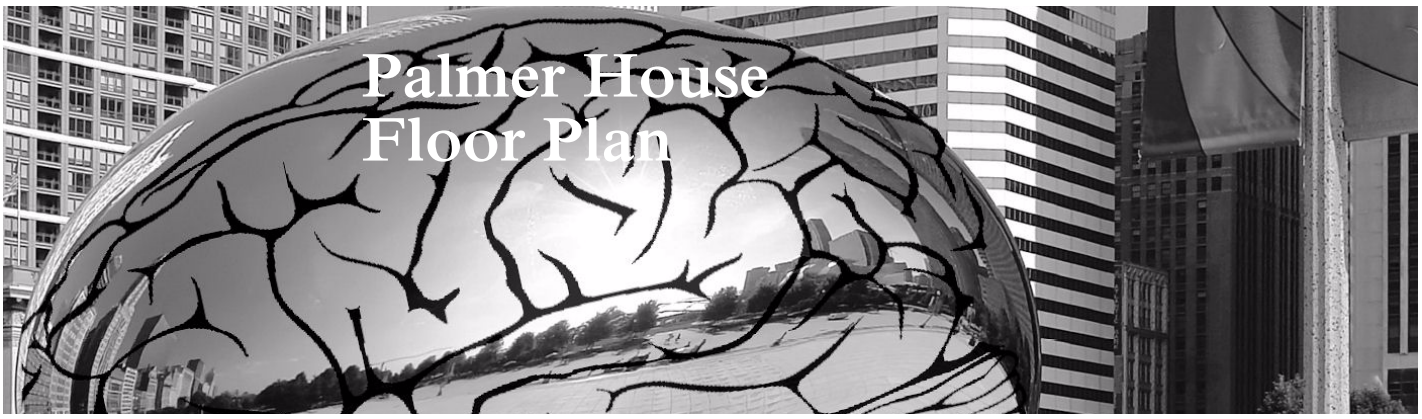
V

W

X

Y

Z



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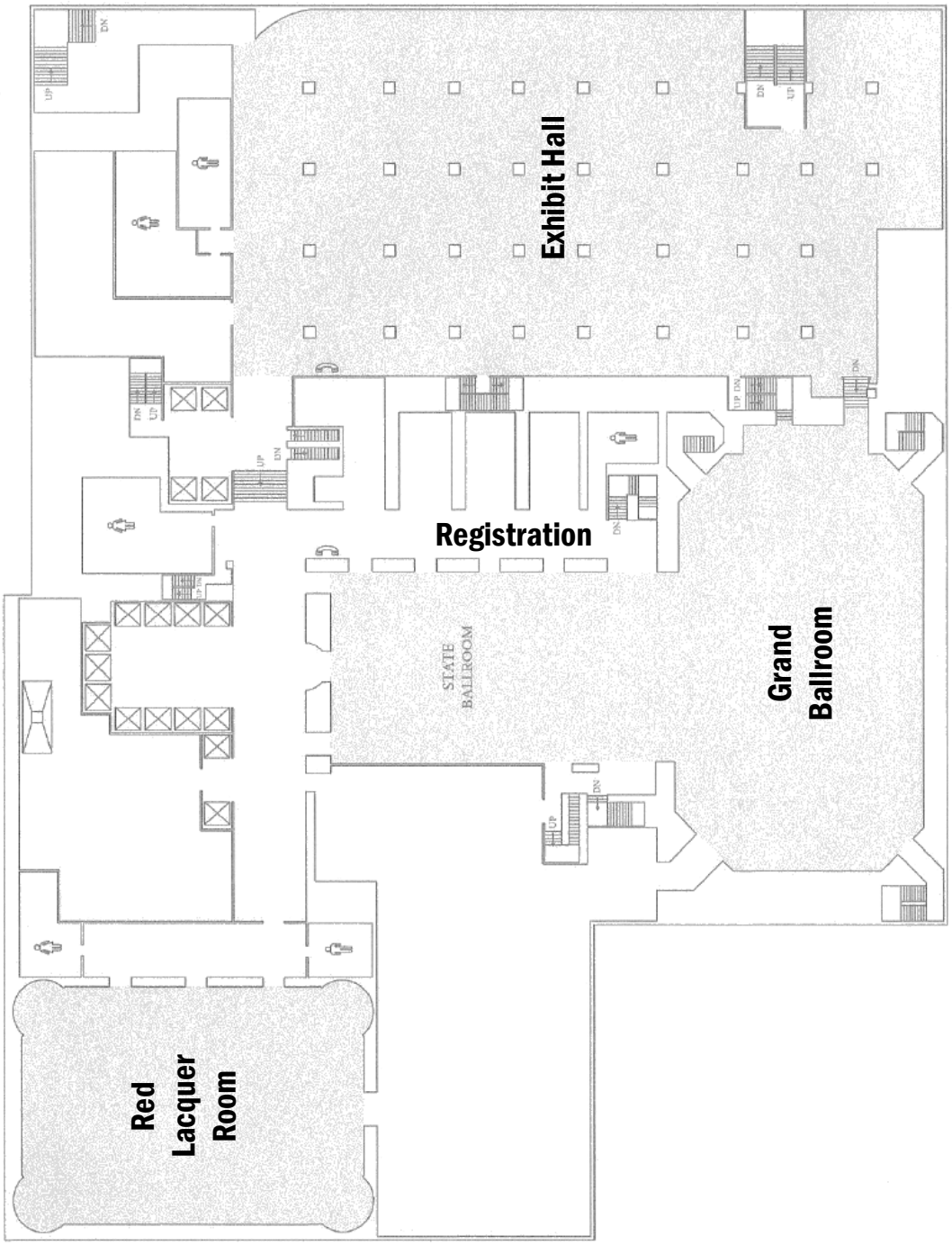

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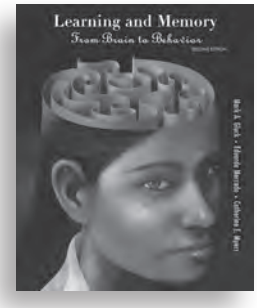

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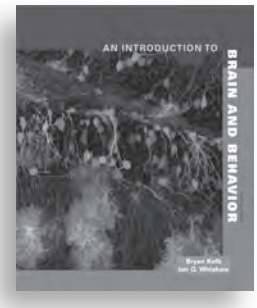

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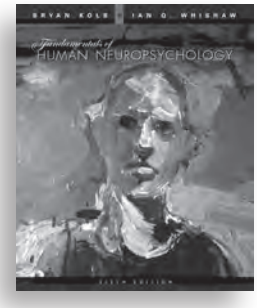

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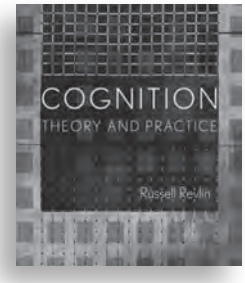

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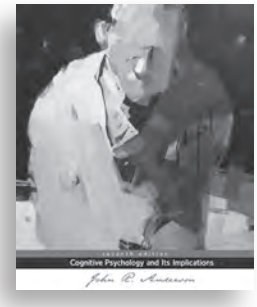

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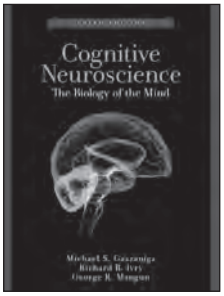

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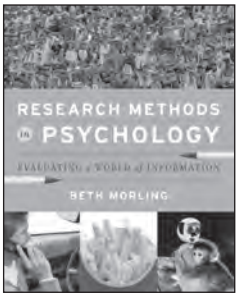

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